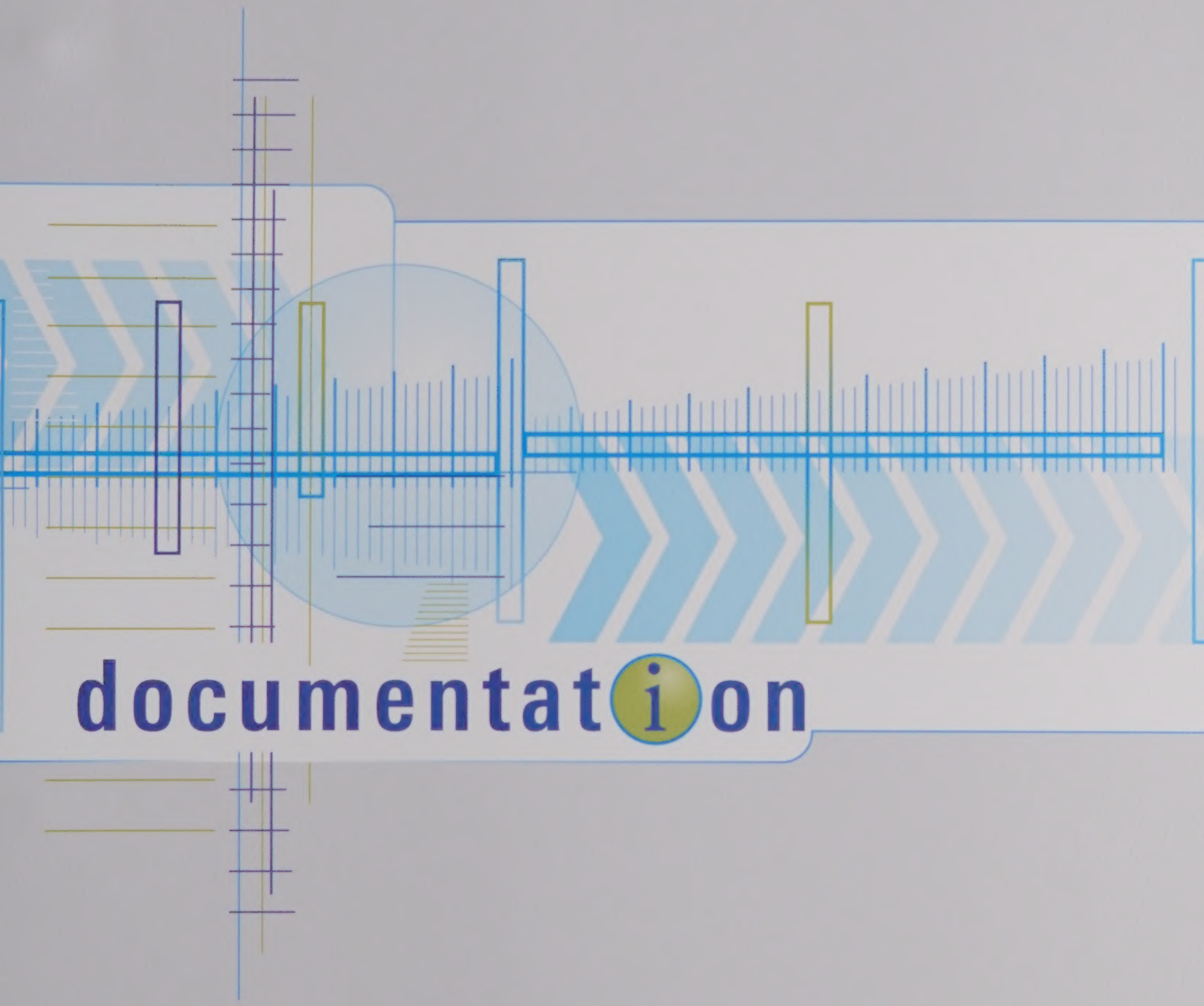

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Test and Measurement
Division

Software Manual

Phase Noise Tests

Application Firmware R&S FS-K40

1161.8138.02

Printed in the Federal
Republic of Germany

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Data sheet

Version 01.00

June 2005

Application Firmware for Phase Noise Measurements R&S®FS-K40

Phase noise measurements with Analyzers R&S®FSP/FSU/FSQ/FSMR

- Editable sweep settings:
  - –Measurement range
  - –Resolution bandwidths
  - –Filter types (analog, digital, FFT)
  - –Averaging
  - –Smoothing factors
- Editable limit lines with pass/fail indication
- Fast residual FM/φM measurements over settable frequency range
- Comprehensive marker functions
- Simultaneous display of up to three traces
- Storage of results and settings
- Remote control via GPIB or LAN

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Application Firmware R&S®FS-K40 adds phase noise measurement capability to the Analyzers R&S®FSP/R&S®FSU/ R&S®FSQ/R&S®FSMR.

Due to their very low inherent phase noise and low noise factor, the R&S®FSU, R&S®FSQ and the R&S®FSMR are ideal for applications that call for very high spectral purity, for example analyzing signal sources such as radio frequency chips used in the modern 3GPP communications standards.

The high phase noise measurement speed is achieved through the high sweep rates of the Rohde & Schwarz analyzers. It is possible to trade off speed against accuracy at small resolution bandwidths (≤10 kHz) by using either FFT or digital/analog filters. The application firmware allows several, different settings within a phase noise diagram, e.g. FFT close to the carrier and analog/digital filters far from the carrier (see Fig. 1).

The large variety of setting options offered by the R&S®FS-K40 allows optimal sweep configuration for your specific measurement task:

- Three predefined settings (Fast, Normal, Averaged) in the Sweep Mode menu make settings easy and produce results quickly. You can of course also configure the measurement yourself and thus adapt the settings optimally to your specific task.
- User-definable carrier offset frequency range from 1 Hz to 1 GHz.
- User-selectable filter type, filter bandwidth and number of averaged sweeps for each carrier offset subrange (1 Hz to 3 Hz/3 Hz to 10 Hz/ 10 Hz to 30 Hz, and so forth).
- Global definition of basic parameters, eliminating the need for tedious presettings (see Fig. 2).
- You can define whether measurements should be started at maximum carrier offset and continued toward smaller offsets or vice versa, so that results are obtained quickly for the subrange of interest.
- Verification of carrier frequency and level prior to each measurement to prevent measurement errors due to frequency drift.
- Autoscaling or user-defined setting of x- and y-axis ranges.
- You can select a trace smoothing factor as required for your application. The original trace and the smoothed trace can be displayed together. It is also possible to apply different smoothing factors to a single trace. The smoothed traces can be displayed together.
- Evaluation lines for residual FM/φM measurements to limit the measurement range.
- User-definable, storable limit lines for fast pass/fail indication.
- Results and settings can be stored and recalled at any time.
- Traces can be stored as ASCII files for subsequent evaluation by means of external tools.
- Application Firmware R&S®FS-K40 is fully remote-controllable via GPIB or LAN.

Fig. 1: Setting of sweep parameters:

The area with a green background on the left shows the currently selected offset frequency measurement range. The fields with a white background can be edited.

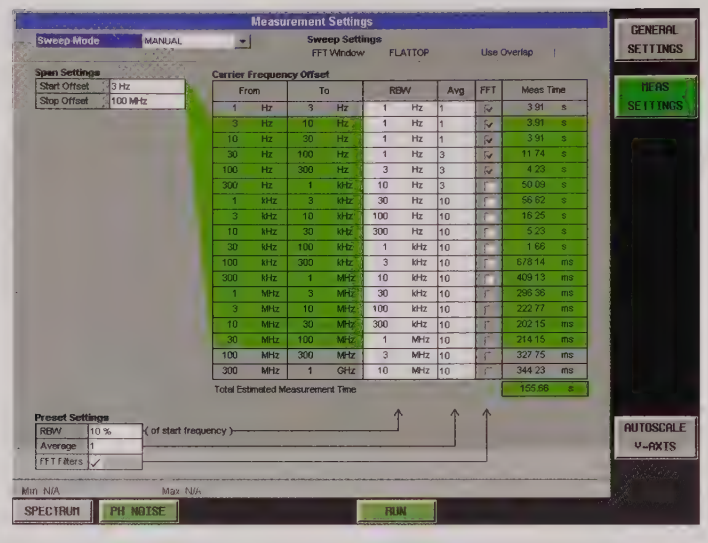


Fig. 2: Setting of global parameters for phase noise measurements:

The basic measurement parameters (carrier level and frequency, display ranges, etc), the residual FM/φM measurement range, as well as discrete offset frequencies of interest are entered here.

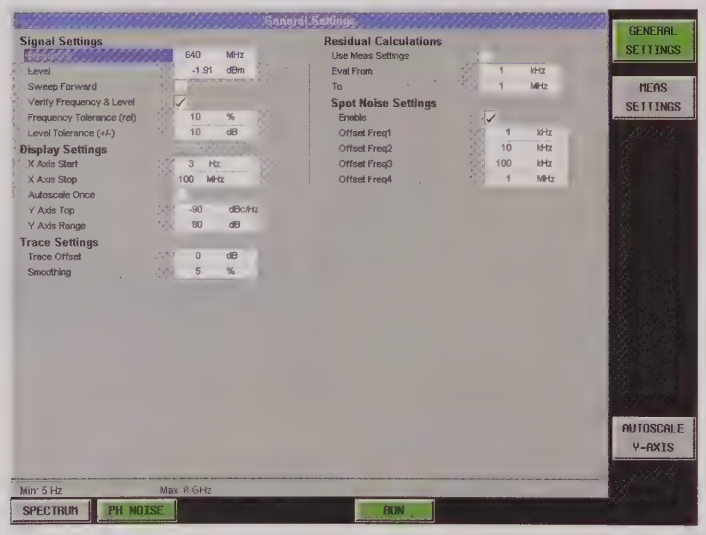
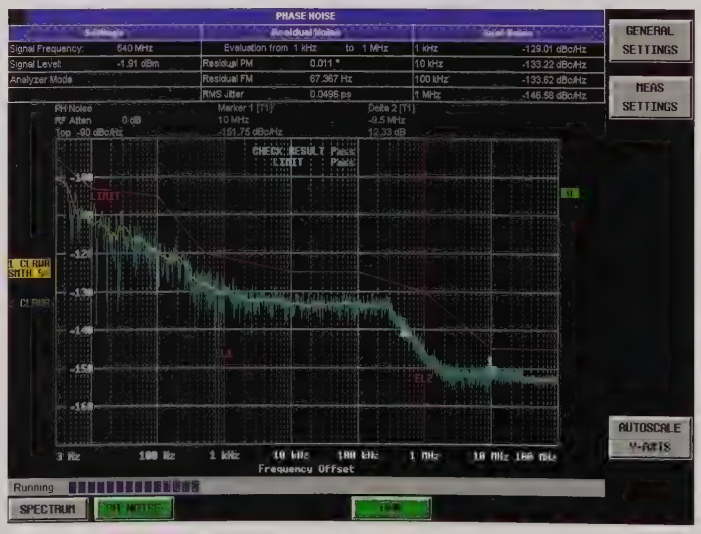


Fig. 3: Phase noise measurement of a signal source: blue trace: original trace; yellow trace: trace with a smoothing factor of 5%.

The red trace is a LIMIT. The measurement result (pass in this example) is displayed directly in the diagram. The vertical red lines mark the range limits for residual FM/φM measurements. Results are displayed in the top center of the screen under Residual Noise.



Specifications

Frequency range	
R&S®FSP3	20 Hz[1]/9 kHz to 3 GHz
R&S®FSP7	20 Hz[1]/9 kHz to 7 GHz
R&S®FSP13	20 Hz[1]/9 kHz to 13.6 GHz
R&S®FSP30	20 Hz[1]/9 kHz to 30 GHz
R&S®FSP40	20 Hz[1]/ 9 kHz to 40 GHz
R&S®FSU3	20 Hz to 3.6 GHz
R&S®FSU8	20 Hz to 8 GHz
R&S®FSU26	20 Hz to 26.5 GHz
R&S®FSU46	20 Hz to 46 GHz
R&S®FSU50	20 Hz to 50 GHz
R&S®FSQ3	20 Hz to 3.6 GHz
R&S®FSQ8	20 Hz to 8 GHz
R&S®FSQ26	20 Hz to 26.5 GHz
R&S®FSQ40	20 Hz to 40 GHz
R&S®FSMR3	20 Hz to 3.6 GHz
R&S®FSMR26	20 Hz to 26.5 GHz
R&S®FSMR50	20 Hz to 50 GHz
The maximum number of decades that can be represented in a phase noise diagram is determined by the user-definable carrier offset frequency range.	
Lower offset limit (inherent residual FM)	
All R&S®FSU/FSQ/FSMR models	1 Hz
All R&S®FSP models	10 Hz
Upper offset limit	
All analyzer models	1 GHz

Measurement accuracy

The level measurement accuracy is mainly determined by the characteristics of the analyzer used. For relevant specifications refer to the corresponding data sheet (see "Related data sheets").

Inherent phase noise

The measurement sensitivity is mainly determined by the analyzer's inherent phase noise.
The diagrams opposite show the typical phase noise characteristics of the analyzers, which can be considered to be the minimum phase noise measurement sensitivity.

[1] With option R&S®FSP-B29

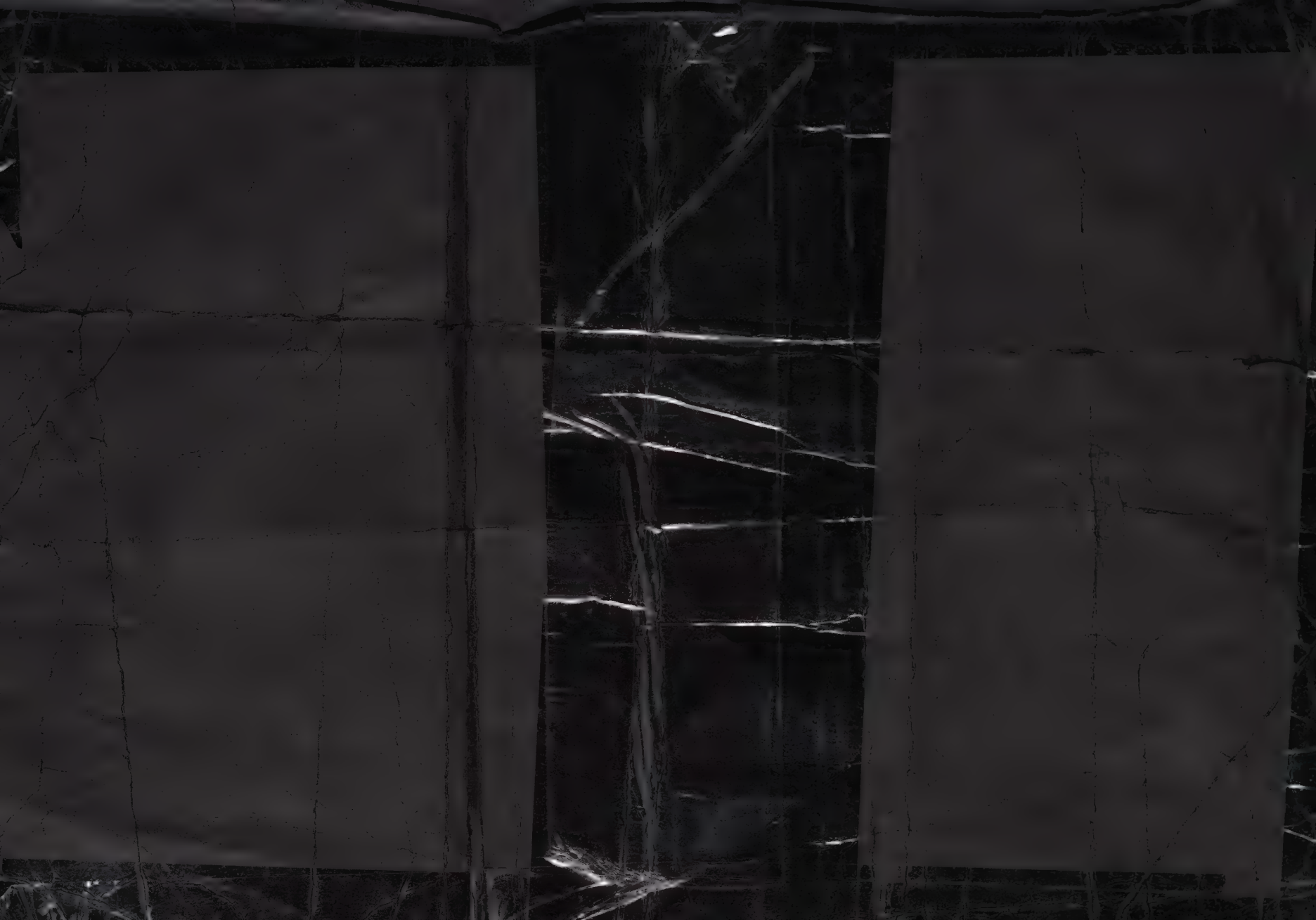


Fig. 4: Typical SSB phase noise versus carrier offset frequency of Analyzers R&S®FSU, R&S®FSQ (from serial No. 2xx xxx) and R&S®FSMR

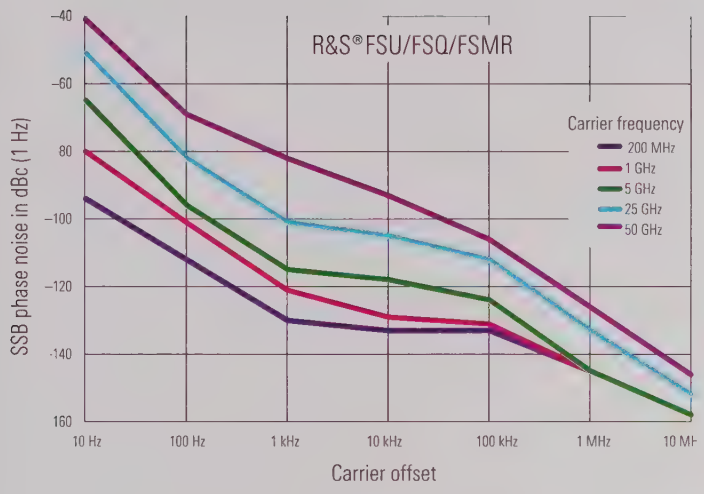
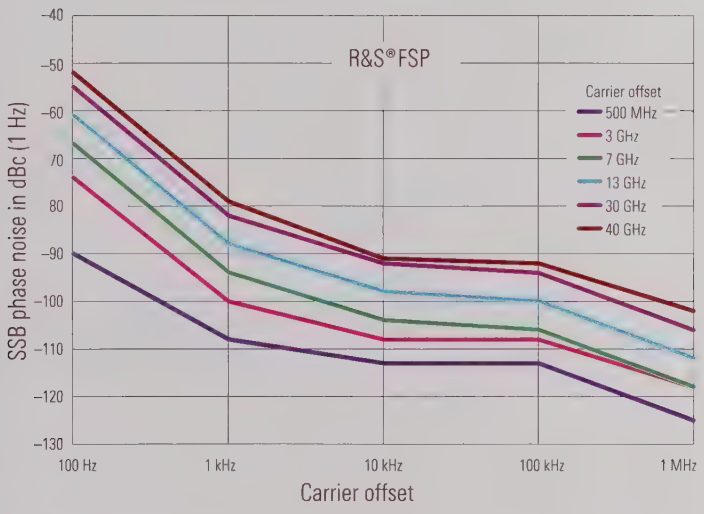


Fig. 5: Typical SSB phase noise versus carrier offset frequency of Spectrum Analyzer R&S®FSP



Ordering information

Application Firmware for Phase Noise Measurements	R&S®FS-K40	1161.8138.02

Related data sheets

Spectrum Analyzers R&S®FSP	PD 0758.1206.21
Spectrum Analyzers R&S®FSU	PD 0758.0016.22
Signal Analyzers R&S®FSQ	PD 0758.0945.21
Measuring Receiver R&S®FSMR	PD 0758.2319.12

More information at
www.rohde-schwarz.com
(search term: FSP/FSU/FSQ/FSMR/FS-K40)

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DIN EN 9100 : 2003
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1 General Information

The Rohde & Schwarz FS-K40 application extends the functionality of the R&S FSP, R&S FSU and R&S FSQ spectrum analyzers to enable phase noise measurements.

This manual supports the user in working with R&S FS-K40. It aids the preparation, execution and evaluation of a measurement and gives many helpful hints and examples.

For the user wanting to make a quick start to using R&S FS-K40, the Quick Start Guide section below works step-by-step through an ordinary phase noise measurement. The remainder of this section describes all of the basic information about how the R&S FS-K40 application works, without covering phase noise measurements in detail. A detailed description of all measurement modes, settings and results can be found in section 2. Section 3 covers remote control operation of R&S FS-K40.

This section covers the following subjects:

- Introduction to R&S FS-K40 & Phase Noisemeasurements
- Installation
- Starting the application
- Exiting the application
- Quick start guide – allows the user to get up-and-running in minimum time
- Navigation
- Save/recall – saving & recalling user settings & measurement results
- Printing
- Limit Lines

Introduction to R&S FS-K40 & Phase Noise Measurements

Phase Noise Measurement Software R&S FS-K40 extends the measurement capabilities of Rohde&Schwarz spectrum analyzers to give a phase noise tester. The R&S FSP, R&S FSU & R&S FSQ are ideal for this purpose because of their low inherent phase noise and noise figure. The high phase noise measurement speed is achieved through the high sweep rates of all analyzers. It is possible to trade off speed against accuracy at small resolution bandwidths (≤1 kHz) by using either FFT or digital filters. The software allows different settings within a phase noise diagram, e.g. FFT close to the carrier and analog/digital filters far off the carrier.

Installation

From the analyzer select firmware update.

➢ Press the SETUP hardkey followed by NEXT, FIRMWARE UPDATE and finally the FIRMWARE UPDATE softkey. Following the instructions displayed.

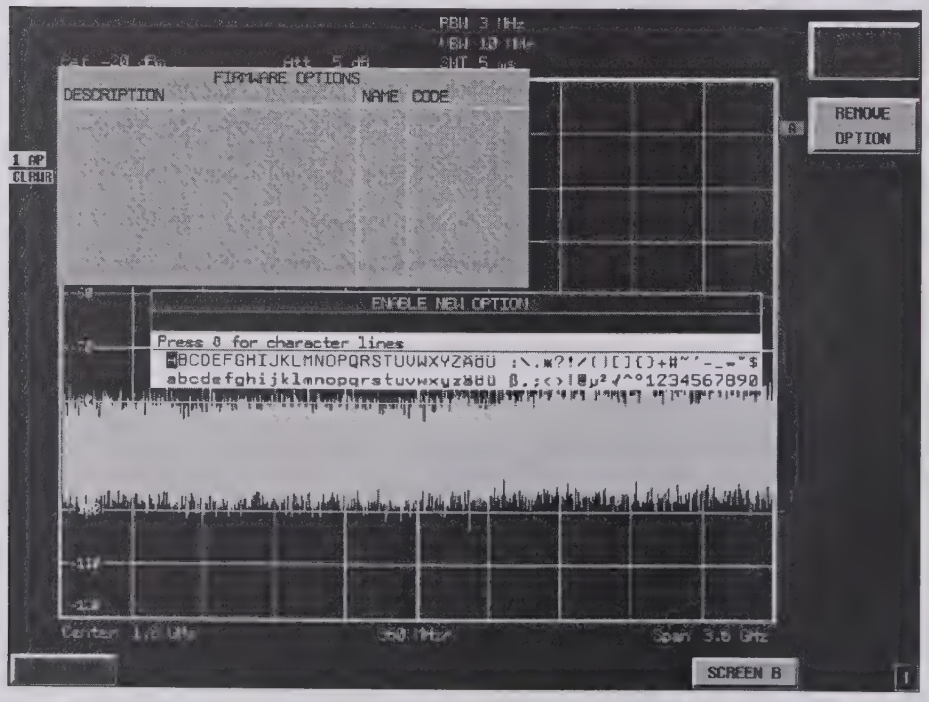
Once the installation has completed the analyzer will reboot.

Once the option has been installed it needs to be activated:

➢ Start up the analyzer

➢ Press the *SETUP* hardkey, followed by the *GENERAL SETUP* softkey and then the *OPTIONS* softkey. A list of the options currently activated is displayed.

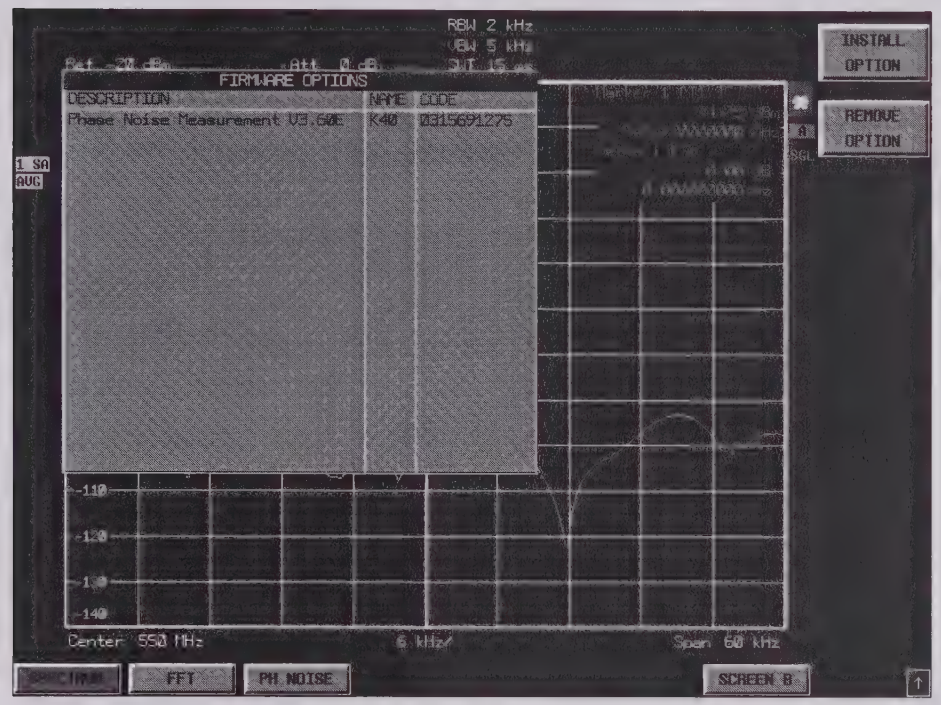
➢ Press the *INSTALL OPTION* softkey. A Dialog is displayed allowing the option key to be entered.



➢ Enter the option key supplied with the R&S FS-K40 software.

➢ When a valid option key has been supplied a dialog will be displayed explaining that a reboot is required to complete this operation. Select OK in this dialog and the instrument will be rebooted

➢ When the analyzer starts after the reboot a new hotkey will be displayed at the bottom of the display labelled *PH NOISE*. In addition an entry for the R&S FS-K40 option will be displayed in the *FIRMWARE OPTIONS* dialog.



Starting the application

Power up the R&S spectrum analyzer. When R&S FS-K40 is correctly installed there will be a hotkey labelled *PH NOISE* at the bottom of the screen. Press the *PH NOISE* hotkey to start R&S FS-K40.

Note that if the spectrum analyzer is powered down whilst R&S FS-K40 is active, then when the spectrum analyzer is powered up again it will start up in the R&S FS-K40 application.

Exiting the application

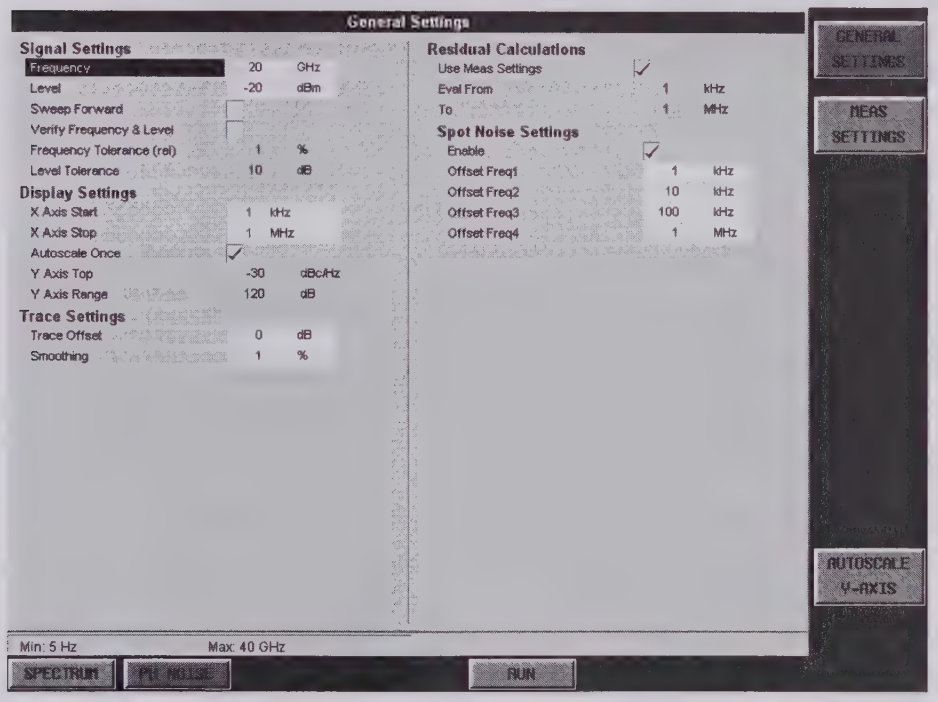
To exit the R&S FS-K40 option, press the *SPECTRUM* hotkey at the bottom of the screen. This will cause the option to exit and the spectrum analyzer to be activated.

Quick Start Guide

This section helps the user to quickly become familiar with R&S FS-K40 by working step-by-step through an ordinary measurement. (Refer to section 2 for a detailed reference guide.)

Setting up the measurement

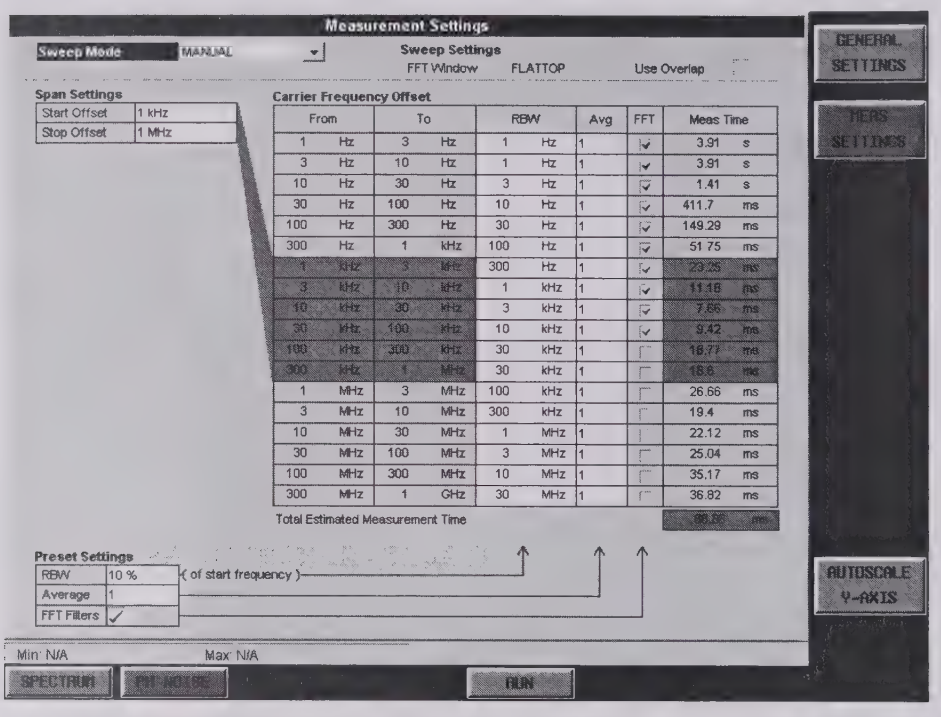
- Start the R&S FS-K40 application.
- Press the *GENERAL SETTINGS* softkey to open the General Settings view.



- Select the *Frequency* field and enter the desired frequency to measure.
- Select the *Level* field and enter the level of the input signal.
- Select the *Verify Frequency & Level* field and ensure the check box is switched off. The setting of this field can be changed by pressing the *ENTER* key or pressing the roll-key

All other settings in this view are sufficient for this example.

➢ Press the *MEAS SETTINGS* softkey to open the Measurement Settings view



➢ Enter the start and stop frequency offsets to measure. Note that the selected range is highlighted in the *Carrier Frequency Offset* table. Note also that the overall expected measurement time is displayed at the bottom of the *Carrier Frequency Offset* table.

➢ Close the Measurement Settings by pressing the *PH NOISE* hotkey or by pressing *ESC*.

Performing the main measurement

Before performing a Phase Noise measurement connect the DUT to the RF Input of the spectrum analyzer.

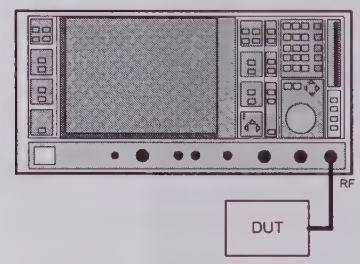
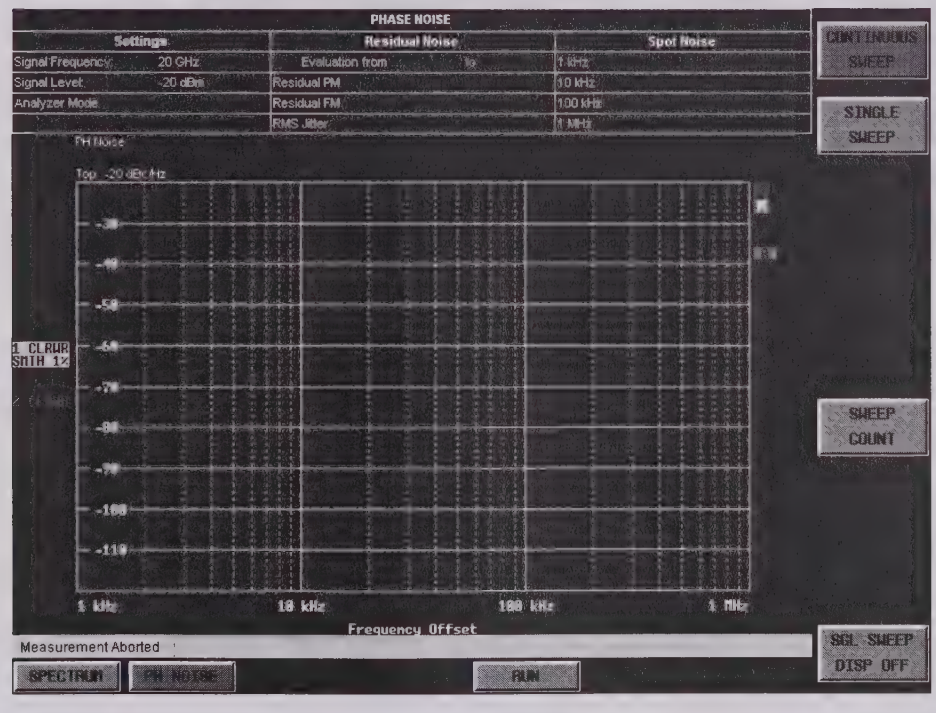


Figure 1-1 Test Setup

➢ Press the *SWEEP* hard-key

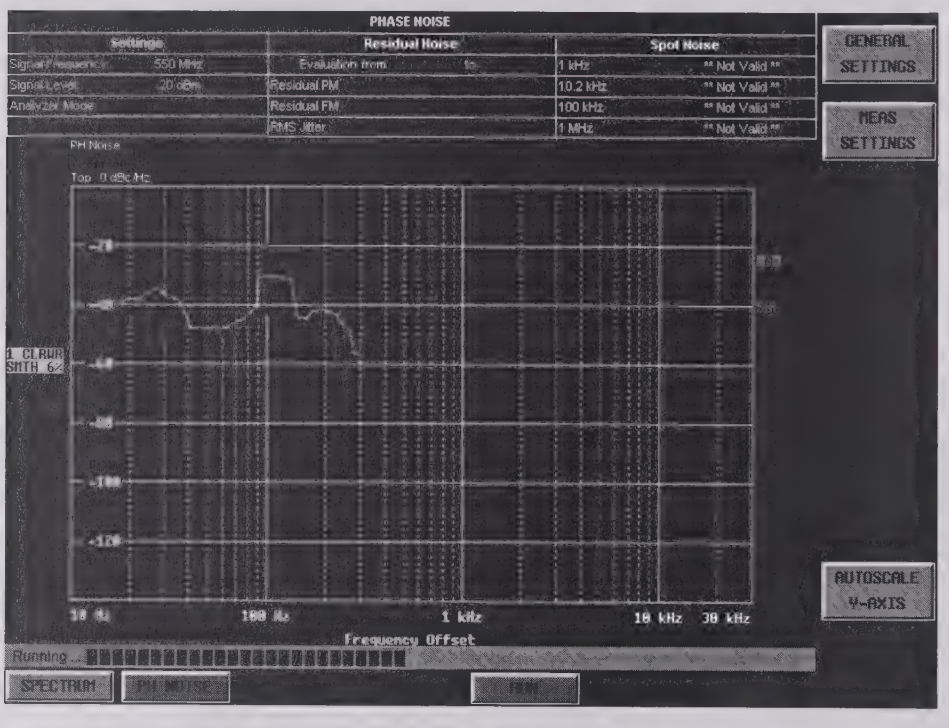


➢ Select a single sweep measurement by pressing the *SINGLE SWEEP* softkey

➢ Start the measurement by pressing the *RUN* hotkey.

➢ During the measurement, the text "*Running...*" is displayed in the Status Bar at the bottom of the screen. The progress bar will update to show progress through the measurement sub-sweeps.

Measurement results are updated whilst the measurement is running. The results are displayed in graphical form. Note that the trace may not be visible during a first measurement if the trace is below the display range. Once the full measurement sweep has completed the trace will rescale to show the trace results.



Navigation

This section deals with navigation within the option. Navigation here is taken to mean all forms of interaction with the option except for remote control. The different methods of interacting with the option are:

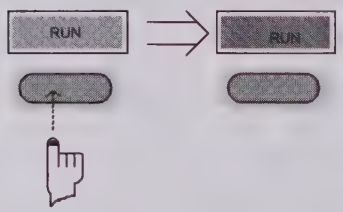
- Hotkeys
- Softkeys
- Hardkeys
- Numeric Keypad
- Roll-key
- Cursor Keys
- External Keyboard
- Mouse

Hotkeys

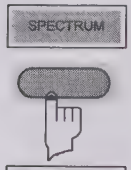
Hotkeys are allocated to the seven keys at the bottom edge of the screen. On initial start-up of the R&S FS-K40 option, the hotkeys provided are shown in Fig. 1-1. These hotkeys are present at all times once the option has been started.

Fig. 1-1 Initial Hotkey menu

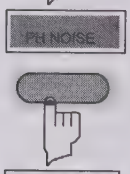
A keystroke activates the associated hotkey. An activated hotkey changes colour to green, as shown.



These hotkeys perform the following operations:

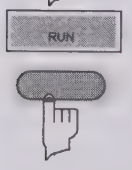


The *SPECTRUM* hotkey exits the R&S FSQ-K40 option & returns to the spectrum analyzer with all previous settings restored.



The *PH NOISE* hotkey returns the user to the main measurement menu of R&S FS-K40, where measurement results can be seen. All settings views and dialogs are removed from the display, and the default softkey menu is displayed

The *PH NOISE* hotkey remains green whenever R&S FS-K40 is active



The *RUN* hotkey starts the selected measurement.

Pressing the *RUN* hotkey whilst a measurement is running causes the measurement to be stopped (aborted).

Softkeys

Settings Softkeys

The softkeys are assigned to the nine keys on the right-hand side of the display. These enable quick access to all of the parameter settings and measurement screens of the K40 option. Each of the top two softkeys, when pressed, brings up a settings view for a group of parameters. These softkeys are always available (except when using Save/Recall and Print manager or controlling markers) and are as follows:

General settings - Signal characteristics, Data Capture, Trigger and IQ settings

Meas settings - specifies details about how the measurement Should be performed

AUTOSCALE Y-AXIS - Updates the Y axis scale according to the current trace results

Fig. 1-2 Main softkeys

Each of these groups of settings is described in detail in the Measurements & Settings section of this manual.

Other Softkeys

All other softkeys have different functions depending on the instrument state. Therefore, the labels (text) on the softkeys will vary to reflect their current function. The state of the softkeys is indicated by different appearances and colours, as follows:

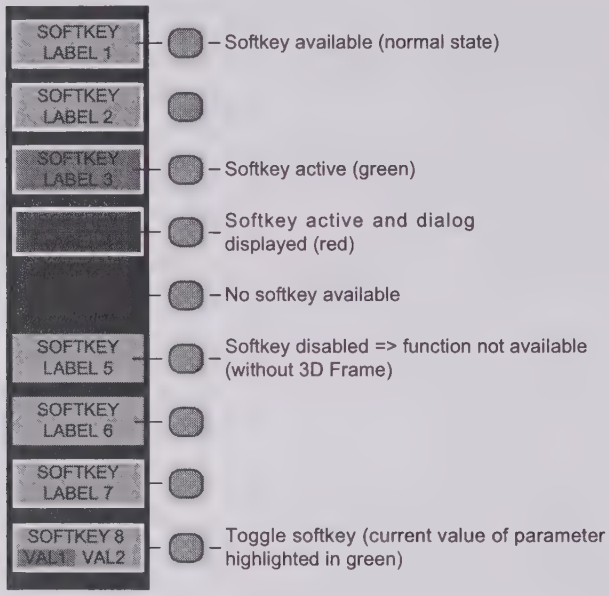

SOFTKEY LABEL 1
SOFTKEY LABEL 2
SOFTKEY LABEL 3
SOFTKEY LABEL 5
SOFTKEY LABEL 6
SOFTKEY LABEL 7
SOFTKEY 8
VAL1 VAL2
Softkey available (normal state)
Softkey active (green)
Softkey active and dialog displayed (red)
No softkey available
Softkey disabled => function not available (without 3D Frame)
Toggle softkey (current value of parameter highlighted in green)

Fig. 1-3 Setup of the softkey area

A softkey in its normal state, where its function is available, is coloured grey with a 3D border.

A softkey that is disabled, because its function is not available, is coloured grey without a 3D border. Softkeys may become disabled because of the state of the instrument or because other settings disable the function associated with the softkey.

An active softkey (highlighted in green) is used when the softkey selects an item or view. For example, the *GENERAL SETTINGS* softkey will be highlighted green when the General Settings view is displayed.

A toggle softkey is used to change the value of a parameter that has only two states. Each press of the softkey toggles the value of the parameter. The current parameter value is highlighted in green in the lower half of the softkey label. For example, in the marker menu, the *MARKER* softkey will have either *NORM* or *DELTA* highlighted in green depending on whether the marker is a normal or delta marker.

When no function is assigned to a softkey then no softkey label will be shown.

Hardkeys

Hardkeys allow quick access to the desired parameter and various functions. The hardkeys supported by the K40 option are as follows (other hardkeys do nothing):

FREQ Hardkey	When the *FREQ* hardkey is pressed the General Settings view is displayed (if it is not already being displayed) and the *Frequency* parameter is selected.
AMPT Hardkey	When the *AMPT* hardkey is pressed the General Settings view is displayed (if it is not already being displayed) and the *Level* parameter for the selected signal input is selected.
BW Hardkey	When the *BW* hardkey is pressed the Measurement Settings view is displayed (if it is not already being displayed) and the *RBW* parameter for the first active sub-sweep is selected.
MKR Hardkey	When the *MKR* hardkey is pressed the main Marker softkey menu is displayed (if it is not already being displayed).
MKR-> Hardkey	When the *MKR->* hardkey is pressed the Marker extension softkey menu is displayed (if it is not already being displayed).
SPAN Hardkey	When the *SPAN* hardkey is pressed the Measurement Settings view is displayed (if it is not already being displayed) and the *RBW* parameter for the first active sub-sweep is selected.
SWEEP Hardkey	When the *SWEEP* hardkey is pressed the Sweep softkey menu is displayed (if it is not already being displayed).
MEAS Hardkey	When the *MEAS* hardkey is pressed the Main softkey menu is displayed (if it is not already being displayed).
TRACE Hardkey	When the *TRACE* hardkey is pressed the Trace softkey menu is displayed (if it is not already being displayed).
LINES Hardkey	When the *LINES* hardkey is pressed the Limit Lines Editor is displayed, containing the list of limit lines relevant to the current measurement.
DISP Hardkey	When the *DISP* hardkey is pressed the Display softkey menu is displayed (if it is not already being displayed).
FILE Hardkey	When the *FILE* hardkey is pressed, the Save & Recall softkey menu is displayed, allowing the save & recall of settings and/or measurement results of the R&S FS-K40option.
PRESET Hardkey	When the *PRESET* hardkey is pressed the R&S FS-K40option is exited and a preset will be performed. Note that all options shall also be preset.
HCOPY Hardkey	When the *HCOPY* hardkey is pressed the print manager softkey menu is displayed, allowing selection of the items to be printed.

External Keyboard

The external keyboard is optional. The keys on the external keyboard that can be used to interact with the R&S FS-K40 option are as follows:

Number keys 0 to 9

Decimal point (".") Inserts a decimal point "." at the cursor position.

Minus key ("-") Changes the sign of the mantissa or exponent of a numeric parameter. A "-" is inserted at the cursor position in the case of an alphanumeric parameter.

ESC key Aborts the entry before it has been terminated. The previous value is restored.
Closes the entry field after termination of input.
Closes pop-up dialogs.

ENTER key Terminates the input of dimension quantities. The new value is set.
Invokes the input of parameters or immediately sets the new value.
Selects the highlighted item in drop-down menus.

Left and Right Cursor Keys are used to: Navigate between individual parameters within the setting views and some of the pop-up dialogs.
Navigate between the individual items within drop-down menus.
Move the cursor left & right inside the entry window to reach a particular position in the string during alphanumeric entry.

Up and Down Cursor keys are used to: Navigate between individual parameters within the setting views and some of the pop-up dialogs.
Navigate between the individual items within drop-down menus.
Increment or decrement the value of a parameter during numeric entry.

CTRL keys Used to activate hotkeys. Each of the seven hotkeys is allocated a different function (F) key. To access these hotkeys press CTRL and the corresponding F key together (see Fig. 1-4):

Fig. 1-4 Quick Access to Hotkeys

Function Keys Used to activate softkeys. Each of the nine softkeys is allocated a different function (F) key. To access these softkeys the corresponding F key, as shown below:

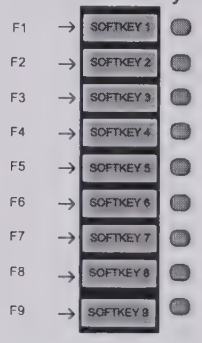


Fig. 1-5 Quick access to softkeys

Mouse

The mouse can be used to select individual parameters within the settings views or data entry dialogs and to activate hotkeys and softkeys. It can also be used to select values from a drop-down list.

Selecting & Editing Parameters

Parameters are set either by numeric or alphanumeric entry or by simple selection from a list of possible values (a drop-down list is used to select an "enumerated" value) or by using checkboxes to turn a parameter setting on and off.

In all cases, the parameter has to be selected by placing focus on it and then editing has to be enabled before its value can be changed.

The rollkey and cursor keys on the front panel are provided for navigation and selection of parameters.

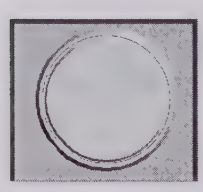
The numeric keypad, rollkey and cursor keys on the front panel and an external keyboard (optional) are provided for the entry of parameter values.

Numeric Keypad

The numeric keypad is provided for entry of numeric parameters. It contains the following keys:

- Number keys 0 to 9
  Starts editing of the selected parameter. This enables a new value to be entered for a parameter directly without having to press *ENTER* first. The digit will be displayed as the first digit of the newly entered value. Inserts a digit at the cursor position when editing an alphanumeric parameter.
- Decimal point
  Inserts a decimal point "." at the cursor position.
- Sign key ("-")
  Changes the sign of the mantissa or exponent of a numeric parameter. A "-" is inserted at the cursor position when editing an alphanumeric parameter.
- Unit keys (GHz/-dBm, MHz/dBm, kHz/dB and Hz/dB)
- Provides the numeric value entered with the selected unit and sets the parameter to that value.
  The unit keys are all assigned the value "1" for dimensionless quantities or for level entries (e.g. in dB). The unit keys thus assume the function of an *ENTER* key.
- *BACK* key
  Deletes the character to the left of the cursor with alphanumeric entry.
- *ESC/CANCEL* key
  Aborts the entry of a new parameter value. The previous value is restored. Closes pop-up dialogs.
- *ENTER* key
  Enables editing of the selected parameter (using numeric keys or rollkey). Finishes the editing of a parameter value. The new value is set. For an alphanumeric value, the new value is set to that displayed (using the current unit if applicable).
  In a drop-down menu, the parameter is set to the currently selected value in the list.

Rollkey



The rollkey has various functions:

- In a settings view, the rollkey can be used to navigate between individual parameters (the parameter selected being highlighted).
- In drop-down menus, the rollkey can be used to navigate between the individual values for the parameter.
- During numeric entry, the parameter is incremented (by turning clockwise) or decremented (by turning counter-clockwise) at a defined step size (depending on the parameter).
- In setting views and data entry dialogs pressing the rollkey invokes the input of parameters or immediately sets the new value, i.e. pressing the rollkey is like pressing the *ENTER* key.
- In drop-down menus, pressing the rollkey selects the relevant item.

Cursor Keys

The keys ⇦ and ⇨ are used to:

- Navigate between individual parameters within the setting views and some of the pop-up dialogs.
- Navigate between the individual values within drop-down menus.
- Move the cursor left & right inside the entry window to reach a particular position in the string during alphanumeric entry.

The keys ⇧ and ⇩ are used to:

- Navigate between individual parameters within the setting views and some of the pop-up dialogs.
- Navigate between the individual items within drop-down menus.
- Increment or decrement the value of a parameter during numeric entry.

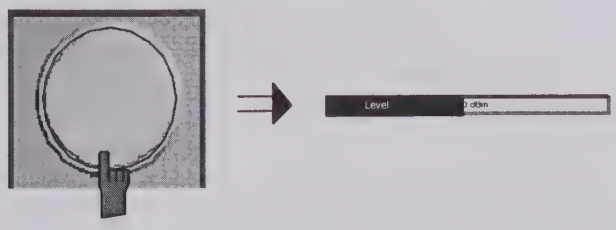
Selection of a parameter within a settings view

Selection using rollkey

➢ Press *GENERAL SETTINGS* softkey for example (General settings view is displayed).

➢ Rotate the rollkey until reaching the required parameter.
Turning the rollkey clockwise selects parameters in the upward direction, turning it counter-clockwise selects parameters in the downward direction.

Example: Selecting *Level* (General settings)



Note: *When the Level parameter is selected its label is highlighted blue.*
When the desired parameter is reached press the rollkey to edit the parameter.

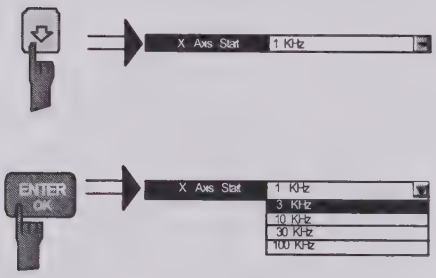
Selection using cursor keys

Cursor [↑], [↓], [←] or [→] until obtaining the required parameter. Within a list of parameters, the *Down* and *Right* both move to the next item (down) in the list and the *Up* and *Left* keys both move to the previous item (up) in the list.
Within a table of parameters, the cursor keys move the cursor in the direction indicated.

To start editing the parameter, either press the *ENTER* key on the numeric keypad, or press the rollkey.

For numeric parameters, editing can also be started by entering the new value directly from the numeric keypad without pressing the *ENTER* key first.

Example: Selecting X-Axis Start



Note: *When ENTER is pressed, a drop-down menu is displayed, which contains all the available settings to which the Demodulator parameter can be set.*

Selection using mouse

➢ Use the mouse to move the cursor to the parameter and press the left mouse button to select the parameter.

➢ To start editing the parameter, either press the *ENTER* key on the numeric keypad, or press the rollkey.

For numeric parameters, editing can also be started by entering the new value directly from the numeric keypad without pressing the *ENTER* key first.

Selection using external keyboard

➢ Select parameter using the cursor keys (in the same way as using the cursor keys on the front panel).

➢ To start editing the parameter, either press the *ENTER* key on the numeric keypad, or press the rollkey.

For numeric parameters, editing can also be started by entering the new value directly from the numeric keypad without pressing the *ENTER* key first.

Entry of a numeric value

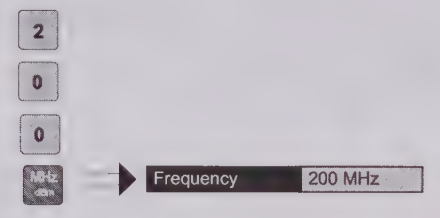
Once a parameter has been selected (see above), a new value for a numeric parameter can be entered in a number of ways. With the exception of entry via the number keys, to start editing the parameter, either press the *ENTER* key on the numeric keypad, or press the rollkey before following the instructions below.

If an error occurs, for example, the entered value is out of range, then the new value will not be accepted for the parameter setting.

Entry using number keys (numeric keypad)

➢ Enter required value using the number keys.

Example: To enter 200 MHz



Note: *The parameter is not set to the new value until either one of the unit keys on the numeric keypad, the ENTER or the rollkey is pressed.*

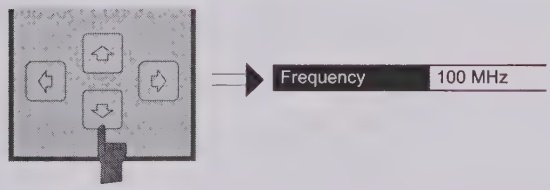
If the new value is not valid, then a message box is displayed and the entered value will be replaced with a valid value. For example, when a value above the maximum allowed is entered, then the maximum value allowed will be shown in the entry box. The parameter will still be ready for editing so that another value can be entered if desired.

Entry using cursor keys

➢ Cursor ⇧ or ⇩ until obtaining the required value.

The application prevents the minimum and maximum values of the parameter from being exceeded and displays an "Out of range" message box if attempted.
N.B The cursor keys increment/decrement a parameter value in large steps.

Example: Cursor down to 100MHz



Note: *Each change of the parameter value takes place immediately. No other keys need to be pressed.*

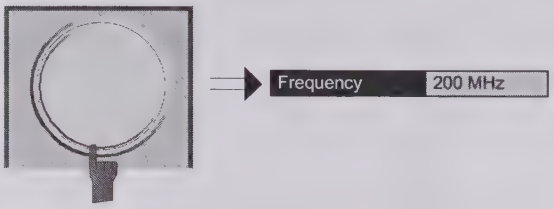
Entry using rollkey

➢ Rotate the rollkey until reaching the required value.

Turning the rollkey clockwise increases the value, turning it counter clockwise decreases the value.

The application prevents the minimum and maximum values of the parameter from being exceeded and displays an "Out of range" message box if attempted.
N.B The rollkeys increment/decrement a parameter value in small steps

Example: Rotate to 200MHz



Note: *Each change of the parameter value takes place immediately. No other keys need to be pressed.*

Entry using external keyboard

➢ Enter value using number keys 0 – 9 in the same way as for using the number keys on the numeric keypad (see above).

Terminating the entry

➢ Press one of the unit keys on the numeric keypad.

The unit is entered in the parameter's edit box and the new parameter value is set immediately.

➢ Press the *ENTER* key (on numeric keypad or external keyboard) or press the rollkey.

The new parameter value is set immediately.

Note: *Pop-up dialogs, where used, do not close automatically. They can be closed by pressing the ESC key.*

In both cases, if the new value is not valid, then a message box is displayed and the entered value will be replaced with a valid value. For example, when a value above the maximum allowed is entered, then the maximum value allowed will be shown in the entry box. The parameter will still be ready for editing so that another value can be entered if desired.

Correcting the entry

➢ Position the cursor to the right of the digit which is to be deleted using the cursor keys ⇦ or ⇨.

➢ Press the BACK key. The digit to the left of the cursor is deleted.

➢ Enter new digits. Each digit is inserted to the left of the cursor, the other digits are shifted right.

Aborting the entry

➢ Press the *ESC* key during parameter editing.

The original parameter value is restored. The new entry is deleted.

➢ If a pop-up dialog is displayed, press the *ESC* key again.

The entry window is closed, the original value remains active.

Entry of an enumerated value

Once a parameter has been selected (see above), a new value for an enumerated parameter can be entered in a number of ways. To start editing the parameter, either press the *ENTER* key on the numeric keypad, press the rollkey or left click with the mouse on the drop down button before following the instructions below.

Note: *When the rollkey or ENTER is pressed, a drop-down menu is displayed, which contains all the available settings that may be selected for the parameter.*

Selection of setting using cursor keys

- Cursor ⇧ or ⇩ until obtaining the required setting.
- Press *ENTER* on external keyboard or numeric keypad, or press rollkey to select the desired setting of parameter.

Note: *Currently selected setting of the parameter is highlighted blue. Pressing ENTER sets the new setting of the parameter immediately.*

Selection of setting using rollkey

- Rotate the rollkey until reaching the required setting.
- Press rollkey to select setting.

Example: Select *Mode* parameter.

Note: *Currently selected setting of the parameter is highlighted blue.*
Pressing the rollkey sets the new setting of the parameter immediately.

Selection of setting using mouse

- When the parameter is selected and ready for editing, select a new setting using the mouse by left-clicking on the new setting from the drop-down list. The new setting of the parameter is set immediately.

Selection of setting using external keyboard

- Select setting using cursor keys.
- Press *ENTER* to set the parameter to the new value.

Entry of a checkbox

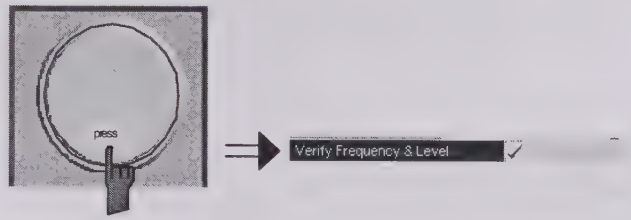
A checkbox is used for parameter settings that are either On or Off (Boolean settings). A checkmark (✓) appears in the box when the setting is On; the checkbox is empty when the setting is Off.

Once a parameter has been selected (see above), a new value for a Boolean parameter can be entered in a number of ways. Because Boolean parameters are very simple, it is not necessary to press the *ENTER* key on the numeric keypad or to press the rollkey in order to edit them.

Toggle between the two states of a checkbox using rollkey

➢ Press the rollkey to toggle between the two states.

Example: Turn *Verify Freequency & Level* setting to Off

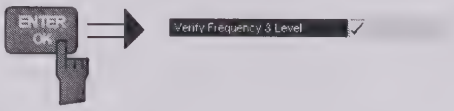


Note: *The checkbox is empty when the settings is Off*

Toggle between the two states of a checkbox using numeric keypad

➢ Press the *ENTER* key to toggle between the two states.

Example: Turn *Auto Level* setting to On



Toggle between the two states of a checkbox using a mouse

➢ Left-click on the checkbox to toggle between the two states.

Toggle between the two states of a checkbox using external keyboard

➢ Press *ENTER* to toggle between the two states.

Status Bar & Title Bar

Title Bar

The title bar is visible at the very top of the display when R&S FS-K40 is active and no settings views are displayed.

Figure 1-2 Title Bar

The centre of the title bar shows the name of the active application. For R&S FS-K40, this is “PHASE NOISE”.

Status Bar

The main status bar is displayed at the bottom of the display, just above the hotkeys.

When a parameter in a settings view is selected, the status bar will display the minimum and maximum, settings for the selected parameter (see Fig. 1-6).

Fig. 1-6 Status Bar

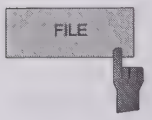
When a parameter whose value is enumerated or Boolean in type is selected in any dialog, the status bar will show “N/A“ displayed for the minimum and maximum, since the minimum and maximum values are “Not Applicable.”

At other times, the status bar shows the current measurement status along with detailed information about the progress through any running measurement.

The status bar is also used to display warning and error messages to the user. In order to highlight these messages, warning messages are displayed with a blue background and error messages with a red background. Refer to Section 4 for a list of warning and error messages.

Save/Recall

This section of the user manual describes the Save/Recall facility of the option.



The *FILE* hardkey brings up the Save/Recall softkey menu. Any settings views on display when the save/recall softkey menu is displayed shall be closed.

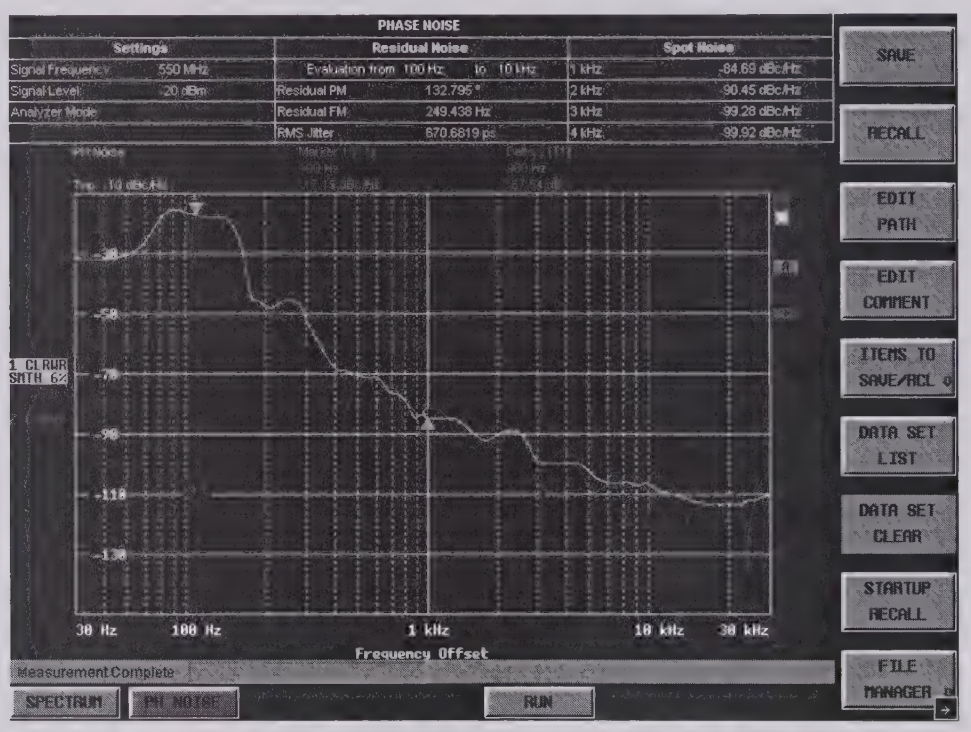


Fig. 1-7 Save/Recall softkey menu

The save/recall facility provided by R&S FS-K40 is exactly the same as that provided by the host analyser. Refer to the user manual for the spectrum analyzer for details of the save/recall facility operation.

The save/recall facility in R&S FS-K40 provides the following items that can be saved and/or recalled:

- Current Settings All user settings provided by R&S FS-K40
- K40 Results All current trace results
- All Limit Lines All limit lines.

To close the save/recall softkey menu and return to the main R&S FS-K40 softkey menu, press the *PH NOISE* hotkey.

Printing

This section of the user manual describes print facility of the option

The *HCOPY* hardkey brings up the print softkey menu. Any settings views on display when the print softkey menu is displayed shall be closed.

Fig. 1-8 Print softkey menu

The print facility provided by R&S FS-K40 is exactly the same as that provided by the host analyser. Refer to the user manual for the spectrum analyzer for details of the print facility operation.

To close the print softkey menu and return to the main R&S FS-K40 softkey menu, press the *PH NOISE* hotkey.

Limit Line

This section of the user manual describes limit line facility of the option.

The *LINES* hardkey brings up Limit Line selection view and softkey menu. Any settings views on display when the limit lines selection view is displayed shall be closed.

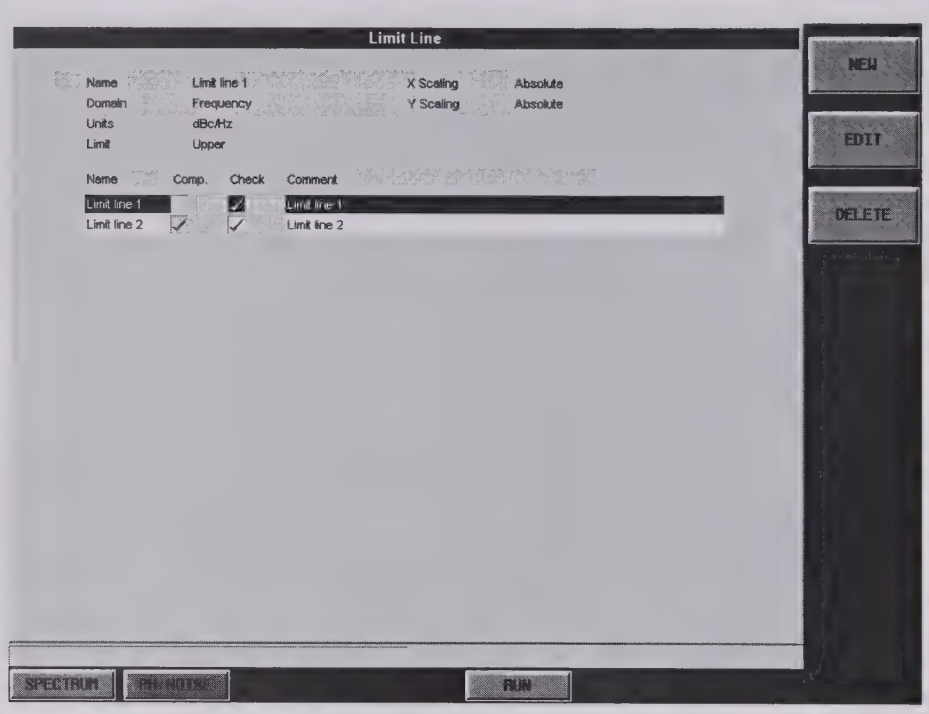


Figure 1-3: Limit Line selection view

From the Limit Line selection view it is possible to add new limit lines, edit existing limit lines, delete limit lines and enable/disable the display of limit lines.

Adding Limit Lines

New limit lines can be defined by pressing the *NEW* softkey from the limit line selection softkey menu.

The *NEW* softkey allows a new limit line to be defined. After pressing the *NEW* softkey the limit line selection view will be replaced with the limit line data view.

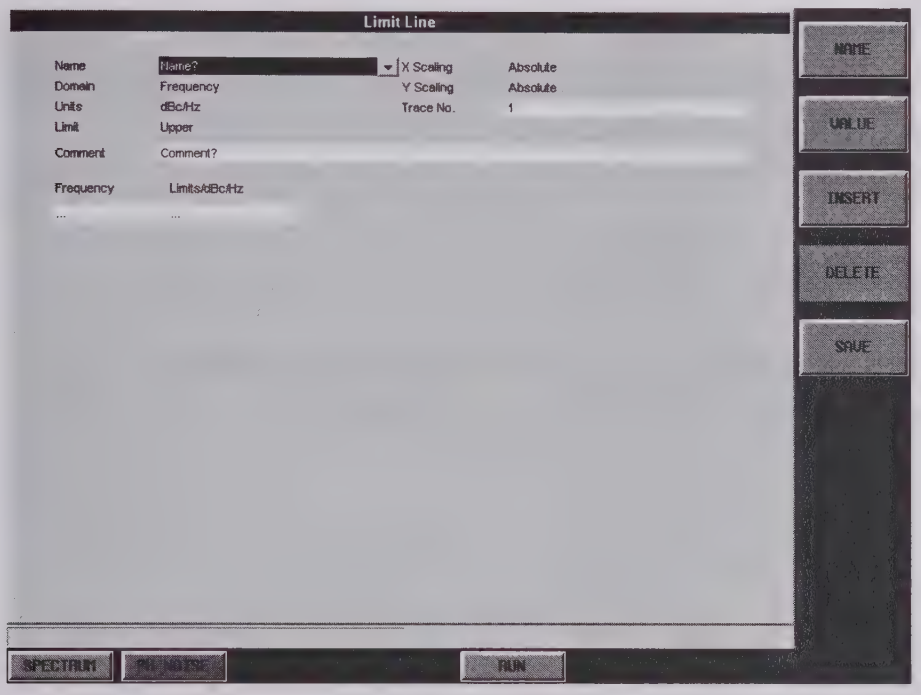


Figure 1-4 Limit Line data view (for a new limit line)

Once the limit line data has been entered as required, press the *SAVE* softkey to save the changes. Pressing the *ESC* hardkey will display a prompt requesting whether the limit line data should be stored or not. Select the appropriate response with the cursor keys or rollkey and hit *ENTER* or press the rollkey to perform the selected action.

Name

The *Name* field allows each limit line to be uniquely identified. The name can contain any combination of number, letters and characters.

Each limit line must have a unique name. An error message will be displayed if a new limit line is added with the same name as an existing limit line.

Pressing the *NAME* softkey will cause the *Name* field to be selected.

Comment

The *Comment* field allows the user to attach a textual description to a limit line. The comment can contain any combination of number, letters and characters.

Trace No.

The *Trace No.* field allows the user to specify the id of the trace to which the limit line is to be applied. Each limit may only be applied to one tarce at a time. Each trace may have multiple limit line applied to it at any given time.

Frequency / Limit Table

The *Frequency/Limit Table* lists the Limit values for specific Frequency values.

When focus is moved to the Frequency/Limit Table at the bottom left of the view, the current parameter in the table is highlighted. Navigation through the table is possible in all four directions using the cursor keys.

It is possible to add individual values directly into the Frequency/Limit Table, including insertion and deletion of *Frequency/Limit* value pairs (rows in the list). The list can contain up to 100 *Frequency/Limit* value pairs. Note that the order of *Frequency* values must be in ascending sequence.

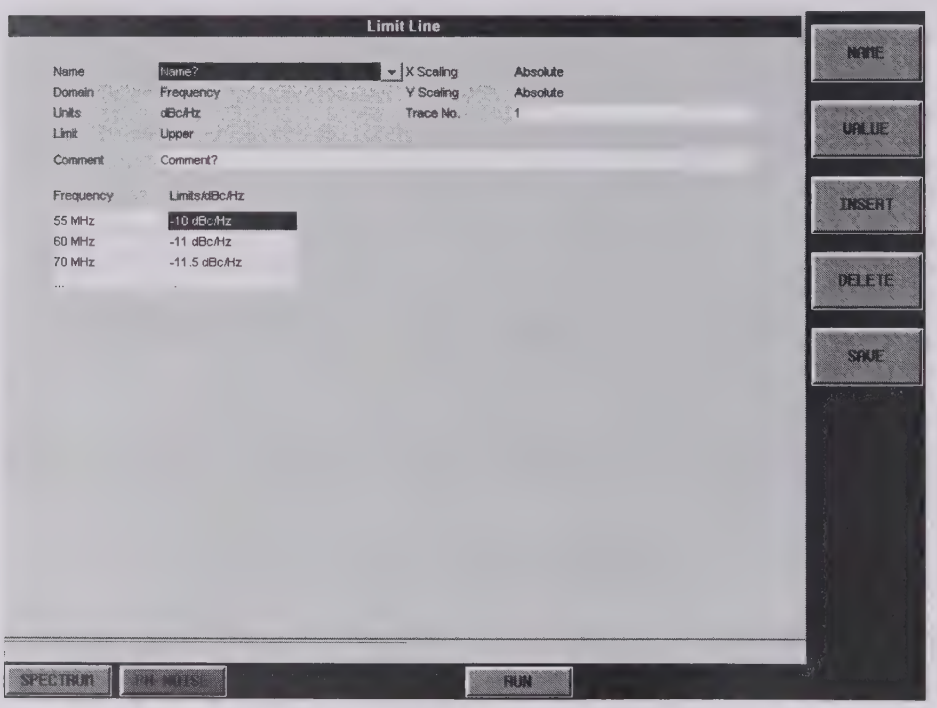
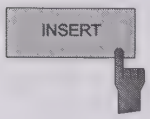


Figure 1-5 Frequency/Limit table



The *INSERT* softkey inserts a new row in the Limit Table directly above the row currently selected. The cursor will be moved to the corresponding column in the new row ready for detailed entry. The *INSERT* softkey shall be disabled when the maximum number of entries in the Limit Table has been reached

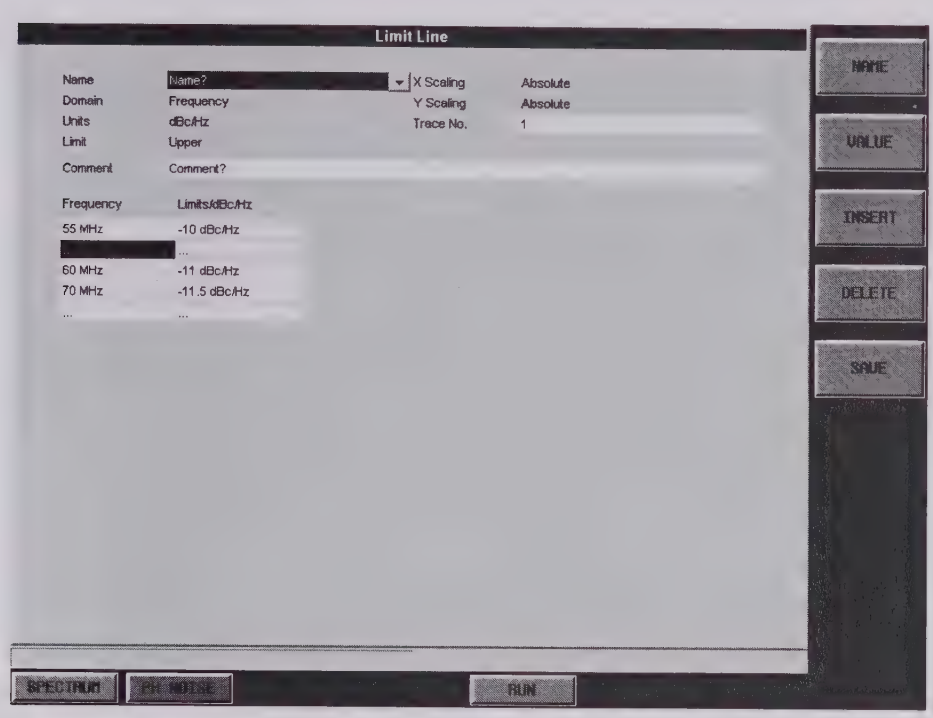
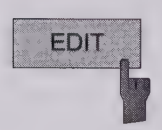


Figure 1-6 Inseting limit line data

The *DELETE* softkey deletes the currently selected row in the Limit Table. Note that no confirmation is required for this action. The cursor will be moved to the corresponding column in the next row.

Modifying Limit Lines

Existing limit lines can be modified by pressing the *EDIT* softkey from the limit line selection softkey menu



The *EDIT* softkey allows the limit line selected in the limit line selection view to be modified. After pressing the *EDIT* softkey the limit line selection view will be replaced with the limit line data view containing the limit line data for the selected limit line.

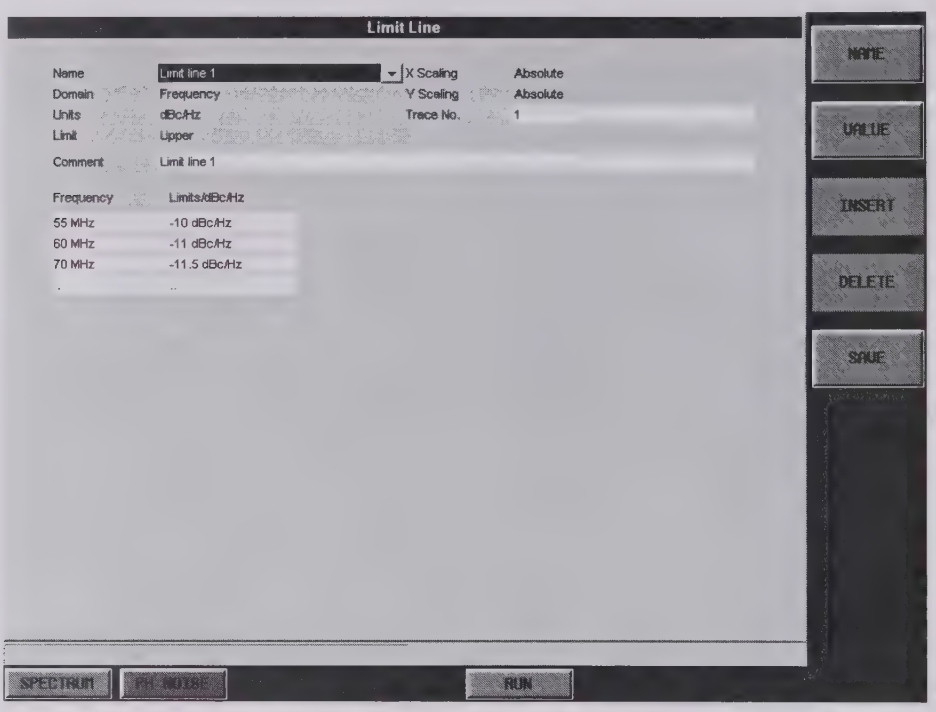


Figure 1-7 Limit Line data view (for an existing limit line)

Once the limit line data has been modified as required, press the *SAVE* softkey to save the changes. Pressing the *ESC* hardkey will display a prompt requesting whether the changes to the limit line data should be stored or not. Select the appropriate response with the cursor keys or scroll key and hit *ENTER* or press the rollkey to perform the selected action.

Deleting Limit Lines

Existing limit lines can be deleted by pressing the *DELETE* softkey from the limit line selection softkey menu

The *DELETE* softkey allows the limit line selected in the limit line selection view to be deleted.

Enabling / disabling Limit Lines

Limit lines can be enabled and disabled. When a limit line is enabled it will be displayed in the relevant results graph, and limit checking will be performed. When a limit line is disabled it will not be displayed and no limit checking for this line will be performed.

To enable/disable a limit line select the required limit line in the limit line selection view. When the required limit line is highlighted press the ENTER key or press the rollkey to toggle the state of the limit line between enabled and disabled. When a limit line is enabled a ✓ symbol is shown in the *Enabled* field. Note that only one limit line of each type can be active at a given time.

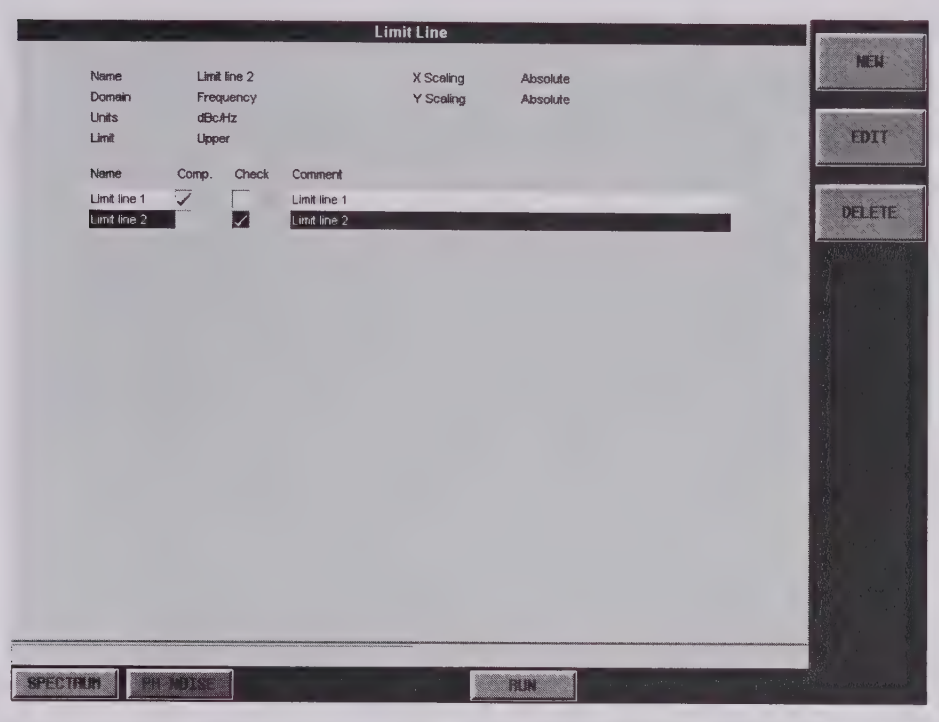


Figure 1-8 Enabling/Disabling limit lines using the Limit line selection view

2 Measurements & Settings

This section contains a detailed description of all measurement modes, settings & results. It covers the following subjects:

- Running measurements
- Measurement results
- General settings
- Measurement settings
- Marker settings
- Trace Settings
- Sweep Settings

Running measurements

Fig. 2-1 Phase Noise Measurement Results

To start a measurement, press the *RUN* hotkey. Pressing the *RUN* hotkey whilst a measurement is running causes the measurement to be aborted.

During a measurement, the text "*Running...*" is displayed in the Status Bar at the bottom of the screen. A progress bar is also displayed to show progress through the current measurement sweep. After successful completion of a single measurement, the Status Bar will display "*Measurement Complete*"

If the Verify Frequency and Level parameter is selected in the General Settings viewthen FS-K40 will then check to see if there is a Signal within the specified Frequency and Level Tolerance ranges relative to the specified Signal Frequency and Level. If no Signal is found, or a Signal is found, which is outside the tolerance range then a message will be displayed in the status bar ("No signals found within tolerance range") and the measurement will be aborted.

Whilst a measurement sweep is running, changing any of the setting int the General Settings or Meas Settings views will cause the measurement to be aborted, apart from the following settings:

- Auto Scale Once
- Y Axis Top
- Y Axis Range
- Residual Calculation Settings

Once a measurement sweep has been performed all active limit lines will be displayed, with the limit result displayed.

Measurement results

The tabular section below the title bar shows the overall measurement settings used to obtain the current measurement results.

PHASE NOISE					
Settings		Residual Noise		Spot Noise	
Signal Frequency:	20 GHz	Evaluation from 1 kHz	to 1 MHz	1 kHz	-64.29 dBc/Hz
Signal Level:	-20 dBm	Residual PM	55.674 °	10 kHz	-112.56 dBc/Hz
Analyzer Mode:		Residual FM	394.769 kHz	100 kHz	-76.13 dBc/Hz
		RMS Jitter	7.7325 ps	1 MHz	-104.00 dBc/Hz

Fig. 2-2 Overall measurement settings summary

The settings summary includes the following information:

- Signal Frequency — The frequency of the measured input signal.
- Signal Level — The level of the input signal
- Evalution — Shows frequency the range over which Residual Noise results are calculated
- Residual PM — Shows the Residual PM result over the selected evaluation range
- Residual FM — Shows the Residual FM result over the selected evaluation range
- RMS Jitter — Shows the RMS Jitter result over the selected evaluation range
- Spot Noise — Shows the spot noise results for the requested frequencies

Note that the Residual Noise results are displayed at the end of a measurement sweep. Once a measurement sweep has been run changing the range for the Residual Noise results in the General Setting view automatically updates the Residual noise results. The range of the Residual Noise calculations is displayed in the results trace with two lines, marker EL1 and EL2.

General Settings

This section of the user manual describes the General Settings view where all settings related to the overall measurement can be modified, that is the Signal Characteristics, Display settings, Trace settings, Residual calculation settings and spot noise settings.

The *GENERAL SETTINGS* softkey brings up the General Settings view.

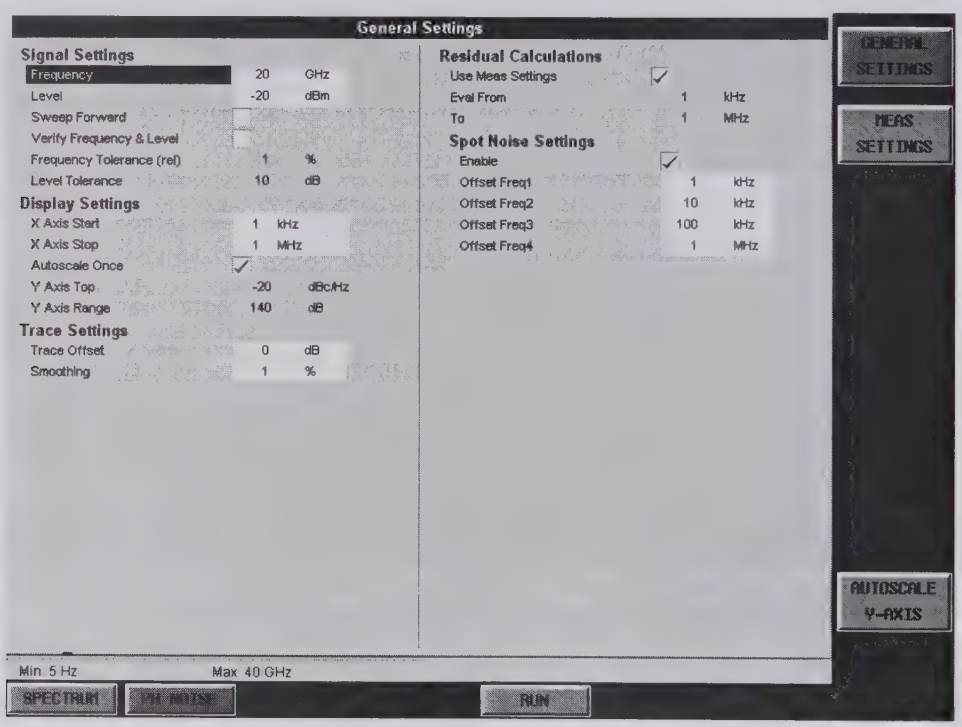


Fig. 2-3 General Settings view

The parameters within the General settings view are logically grouped together into:

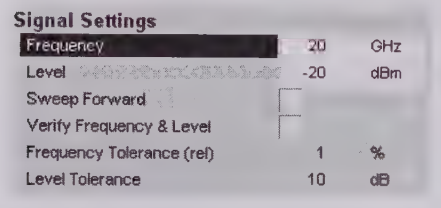
- Signal Settings
- Display Settings
- Trace Settings
- Residual Calculations
- Spot Noise Settings

Any parameters that are not available for editing will have a grey background. This usually occurs when one parameter setting makes another parameter invalid, for example if the *Verify Frequency and Level* is switched off then none of the parameters below this (*Frequency Tolerance* and *Level Tolerance*) have any meaning, so these parameters are greyed out.
When a particular parameter is selected within the General Settings view the status bar changes to display information about the valid settings for the selected parameter.

Signal Settings

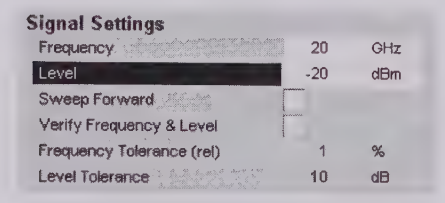
The Signal Settings are the general settings concerning the level and frequency of the signal to be measured.

Frequency



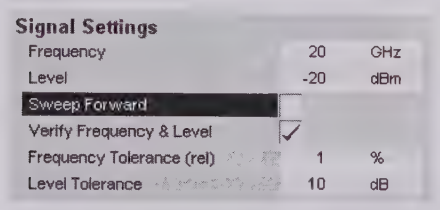
Frequency specifies the Center Frequency of the signal to be measured.

Level



Level specifies the expected level of the RF input signal.

Sweep Forward

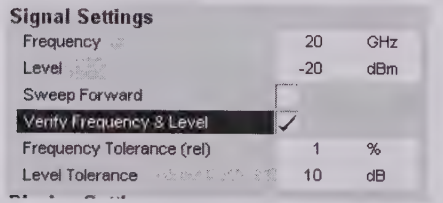


Sweep Forward is used to determine the sweep direction for the current measurement.

If *Sweep Forward* is on the measurement will be done from the start offset frequency to the stop offset frequency.

If *Sweep Forward* is off the measurement will be done from the stop offset frequency to the start offset frequency.

Verify Freq and Level

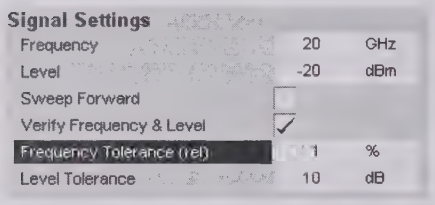


Verify Freq enables a search across a frequency tolerance range, for the carrier of greatest magnitude. Carrier frequency and level are measured. If the level is within a level tolerance range, the measured level overrides the specified *Level*. Otherwise the measurement is aborted.

This should be used when the carrier frequency is not known precisely.

When *Verify Freq* is ON, *Frequency Tolerance* and *Level Tolerance* parameters become enabled.

Frequency Tolerance

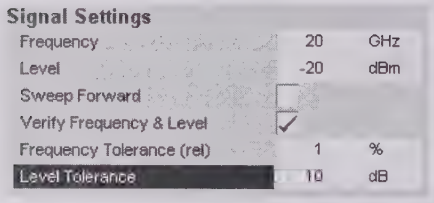


Frequency Tolerance is used to verify the input signal frequency.

If the sweep direction is forward, the *Frequency Tolerance (absolute)* parameter is used, which is the range, either side of the *Signal Frequency*, within which the carrier is known to be. In forward sweep there will be a frequency and level check once at the beginning of the measurement.

If the sweep direction is reverse, the *Frequency Tolerance (relative)* parameter is used, which is the ratio of the subspan's start frequency. In reverse sweep there will be a frequency and level check before each subsweep.

Level Tolerance

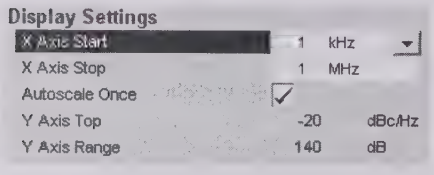


Level Tolerance parameter is an offset relative to the *Level*. It is used to verify the *Level* of the input signal.

Level Tolerance specifies the maximum and mimum deviation from the specified Level setting that the input signal may vary by and still pass the verification i.e. measured level between (*Level+Level_Tolerance*) and (*Level-Level_Tolerance*) is accepted

Display Settings

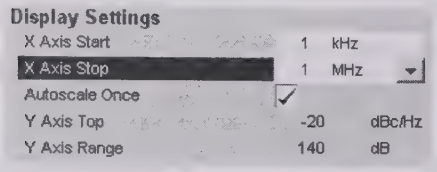
X Axis Start



X Axis Start parameter specifies the min frequency for the X axis.

When *X Axis Start* changes the *Start* parameter in Measurement Settings view gets updated accordingly.

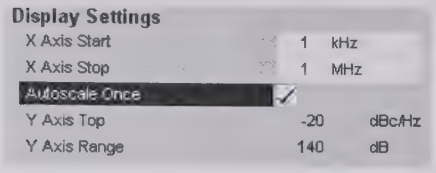
X Axis Stop



X Axis Stop parameter specifies the max frequency for the X axis.

When *X Axis Stop* changes the *Stop* parameter in Measurement Settings view gets updated accordingly.

Autoscale Once

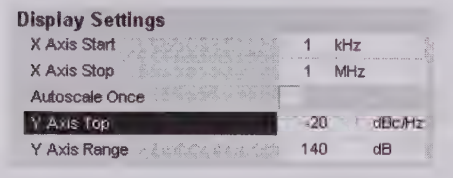


If the *Autoscale Once* is ON, the y-axis scaling is calculated from results .

The autoscaling will only be done once in the first sweep. The subsequence sweeps will not auto scale the y-axis.

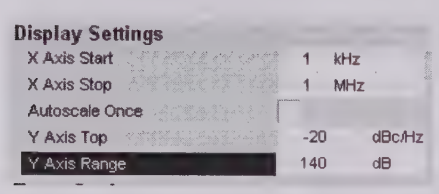
When *Autoscale Once* is ON, *Y Axis Top* and *Range* parameters will be greyed out. When it is OFF, *Y Axis Top* and *Range* parameters will be editable.

Y Axis Top



Y Axis Top parameter specifies the max Phase Noise level in y-axis for the trace results.

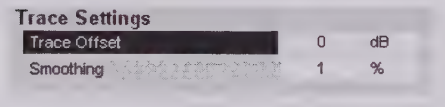
Y Axis Range



Y Axis Range parameter specifies the distance from the top to the origin in y-axis.

Trace Settings

Trace Offset



Trace Offset is an arithmetical reference level offset which is added to the y axis labelling.

Smoothing

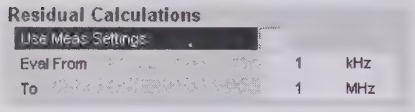
Smoothing specifies the % of the display width to be used as a window when a trace is smoothed.

The larger the setting of the *Smoothing* parameter the greater the effect of smoothing.

For more details regarding smoothing and the algorithm used see section *Trace Menu*

Residual Calculations

Use Meas Settings

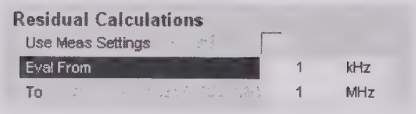


Use Meas Settings specifies whether to use the whole measurement range or the user defined evaluation range for the residual calculations.

If the *Use Meas Settings* is switched on then the *Eval From* and *To* become disabled and residual calculations are performed across the complete range of the measurement results

If the *Use Meas Settings* is switched off then the *Eval From* and *To* become enabled and allow the range over which residual calculations are performed to be specified

Eval From



Eval From specifies the start of the measurement range for which residual calculations are to be performed

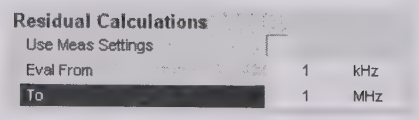
The minimum value that can be specified for the *Eval From* setting is the value of the *X Axis Start* setting

The maximum value that can be specified for the *Eval From* setting is the value of the *X Axis Stop* setting

When the *X Axis Start* or *X Axis Stop* settings are modified the *Eval From* will be automatically adjusted to ensure that it is not outside the measurement range

The *Eval From* setting cannot be set higher than the *To* settings

To



To specifies the end of the measurement range for which residual calculations are to be performed

The minimum value that can be specified for the *To* setting is the value of the *X Axis Start* setting

The maximum value that can be specified for the *To* setting is the value of the *X Axis Stop* setting

When the *X Axis Start* or *X Axis Stop* settings are modified the *Eval From* will be automatically adjusted to ensure that it is not outside the measurement range

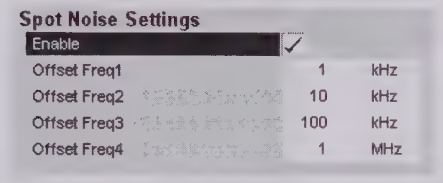
The *To* setting cannot be set lower than the *Eval from* settings

Spot Noise Settings

The Spot Noise settings allows up to 4 discrete frequency points to be specified where the Phase Noise result from a measurement sweep can be obtained and displayed.

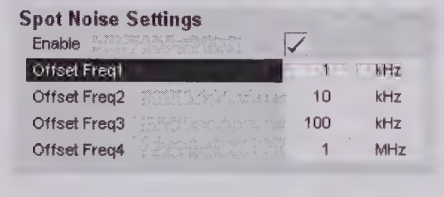
Spot Noise results are updated whilst a sweep is running.

Enable



The *Enable* settings allows spot noise calculations to be switched on and off

Offset Freq1,2,3,4Offset Freq



The *Offset Freq* parameters allow up to four frequency points to be specified at which spot noise calculations will be performed.

If an offset frequency is specified which is outside the measurement frequency range then no results will be displayed fo that offset frequency.

Meas Settings

This section of the user manual describes the Meas (Short for Measurement) Settings view where the settings associated with measurement sweep are specified.

The *MEAS SETTINGS* softkey brings up the Meas Settings view.

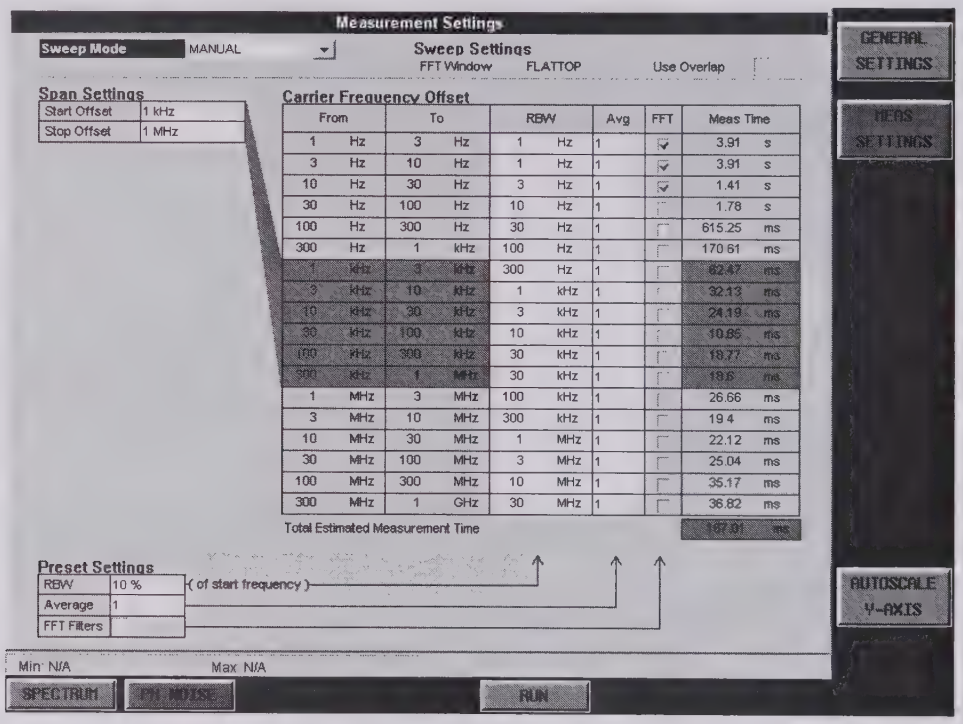

Measurement Settings
Sweep Mode
MANUAL
Sweep Settings
FFT Window
FLATTOP
Use Overlap
Span Settings
Start Offset
1 kHz
Stop Offset
1 MHz
Carrier Frequency Offset
From
To
RBW
Avg
FFT
Meas Time
1 Hz 3 Hz 1 Hz 1 3.91 s
3 Hz 10 Hz 1 Hz 1 3.91 s
10 Hz 30 Hz 3 Hz 1 1.41 s
30 Hz 100 Hz 10 Hz 1 1.78 s
100 Hz 300 Hz 30 Hz 1 615.25 ms
300 Hz 1 kHz 100 Hz 1 170.61 ms
1 kHz 3 kHz 300 Hz 1 62.47 ms
3 kHz 10 kHz 1 kHz 1 32.13 ms
10 kHz 30 kHz 3 kHz 1 24.19 ms
30 kHz 100 kHz 10 kHz 1 18.85 ms
100 kHz 300 kHz 30 kHz 1 18.77 ms
300 kHz 1 MHz 30 kHz 1 19.6 ms
1 MHz 3 MHz 100 kHz 1 26.66 ms
3 MHz 10 MHz 300 kHz 1 19.4 ms
10 MHz 30 MHz 1 MHz 1 22.12 ms
30 MHz 100 MHz 3 MHz 1 25.04 ms
100 MHz 300 MHz 10 MHz 1 35.17 ms
300 MHz 1 GHz 30 MHz 1 36.82 ms
Total Estimated Measurement Time
Preset Settings
RBW 10 % (of start frequency)
Average 1
FFT Filters
Min: N/A
Max: N/A
SPECTRUM
RUN
GENERAL SETTINGS
MEAS SETTINGS
AUTOSCALE Y-AXIS

Fig. 2-4 Meas Settings view

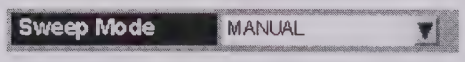
The Meas settings are logically grouped together into:

- Sweep mode
- Span Settings
- Carrier Frequency Offset
- Preset Settings

When a particular parameter is selected within the Meas Settings view the status bar changes to display information about the valid settings for the selected parameter.

Sweep Mode Settings

Sweep Mode



When the *Sweep Mode* parameter is set the Carrier Frequency Offset Table gets updated from the instruments default settings .

The possible values of the *Sweep Mode* parameter are:

Fast Not averaged. The measurement runs very fast. As the average column is set to 1 for all sub-bands.

Normal Normal averaged. The measurement runs slower then the *fast* mode, but the sub-bands are averaged more.

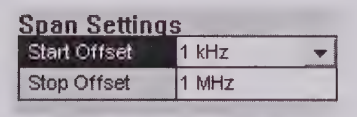
Averaged Highly averaged. The measurement runs very slow with high average in each sub-band for more accurate results.

Manual The *RBW*, *Average* and *FFT* columns can be set by the user.

In fast, normal and avaeraged modes, the table is not editable, it is information only.

Span Settings

Start Offset

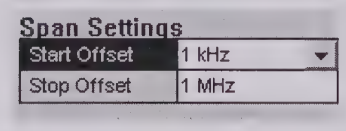


Start Offset Defines the start frequency of the measurement.

When this parameter changes the X-axis *Start* parameter in General Settings (Noise) view gets updated accordingly.

The Carrier Frequency Offset Table is highlighted to show the selected span for the noise measurement.

Stop Offset

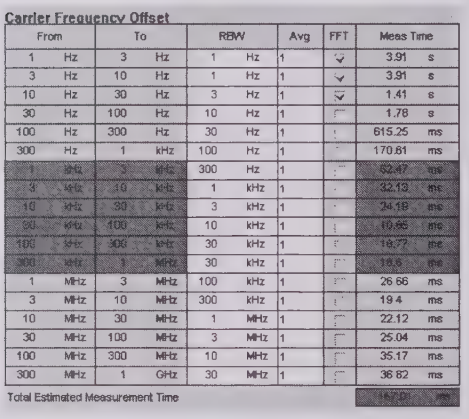


Stop Offset – Defines the stop frequency of the measurement.

When this parameter changes the X-axis *Stop* parameter in General Settings (Noise) view gets updated accordingly.

The Carrier Frequency Offset Table is highlighted to show the selected span for the noise measurement.

Carrier Frequency Offset Table



Carrier Frequency Offset

From	To	RBW	Avg	FFT	Meas Time
1 Hz	3 Hz	1 Hz	1	☑	3.91 s
3 Hz	10 Hz	1 Hz	1	☑	3.91 s
10 Hz	30 Hz	3 Hz	1	☑	1.41 s
30 Hz	100 Hz	10 Hz	1	☐	1.78 s
100 Hz	300 Hz	30 Hz	1	☐	615.25 ms
300 Hz	1 kHz	100 Hz	1	☐	170.61 ms
1 kHz	3 kHz	300 Hz	1	☐	62.47 ms
3 kHz	10 kHz	1 kHz	1	☐	32.13 ms
10 kHz	30 kHz	3 kHz	1	☐	24.18 ms
30 kHz	100 kHz	10 kHz	1	☐	19.95 ms
100 kHz	300 kHz	30 kHz	1	☐	18.77 ms
300 kHz	1 MHz	30 kHz	1	☐	18.6 ms
1 MHz	3 MHz	100 kHz	1	☐	26.66 ms
3 MHz	10 MHz	300 kHz	1	☐	19.4 ms
10 MHz	30 MHz	1 MHz	1	☐	22.12 ms
30 MHz	100 MHz	3 MHz	1	☐	25.04 ms
100 MHz	300 MHz	10 MHz	1	☐	35.17 ms
300 MHz	1 GHz	30 MHz	1	☐	36.82 ms

Total Estimated Measurement Time 187.01 ms

From: This column lists the start frequency of each sub-band.

To: This column lists the stop frequency of each sub-band.

RB: – This column lists the resolution filter bandwidth used for each sub-band. Enter values in steps of 1/3/10.

Range: 0.1 % .. 30 % of the start frequency in that row.

Average: This column lists the number of sweeps to average over for each sub-band.

Range: 1 .. 10000

FFT: It allows the user to choose whether to use the FFT Resolution Filter or the conventional filter for each decade.
FFT is only available for RBW values between 1 Hz and 30 kHz.

Meas Time: Shows the estimated measurement time for each sub-band. Note this time is for the measurement only and does not include processing time.

An overall measurement time is displayed at the bottom of the table showing the overall measurement time for the selected sub-bands.

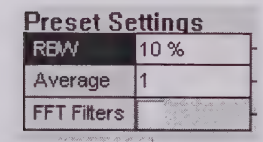
Preset Settings

The Preset Settings group provides a short-cut method quickly configuring the settings in the Carrier Frequency Offset table.

Settings any of the settings in the Preset Settings group sets all the appropriate settings in the carrier offset table.

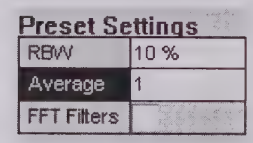
Note that when the *Sweep Mode* parameter is set to any value other than Manual then the Preset Settings group is disabled

RBW:



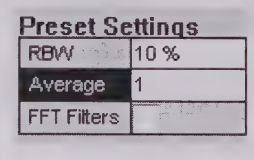
The *RBW* parameter sets all the RBW settings in the Carrier Frequency Offset table to a proportion of the start frequency for each sub-band. The resulting RBW is rounded to the nearest 1/3/10 steps.

Average:Average



The *Average* parameter sets all the Average settings in the Carrier Frequency Offset table to the specified value.

FFT:FFT



The *FFT* parameter sets all the FFT settings in the Carrier Frequency Offset table to the specified value.

Note that only those sub-bands where FFT filters are available will have FFT filters enabled if this parameter is switched on.

Markers

This section of the user manual describes the Marker facility of the option.

The markers are used for marking points on traces, reading out measurement results and for quickly selecting a display section. R&S FS-K40 provides four markers. All markers can be used either as markers or delta markers.

The marker that can be moved by the user is defined in the following as the **active marker**.

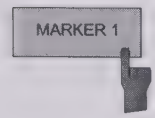
The *MKR* hardkey brings up the marker softkey menu. Any settings views on display when the marker softkey menu is displayed shall be closed.

Fig. 2-5 Marker Menu

From the marker menu it is possible to adjust the marker position, change marker mode between normal and delta and switch the marker display on and off

Adjusting Markers

The marker can be adjusted by pressing the marker softkey in the marker softkey menu



The *MARKER* softkeys displays the Marker pop-up dialog for the appropriate marker (1 to 4).

As soon as an field in the marker pop-up dialog is adjusted then the marker position in the trace will update, along with the results displayed for the marker.

Marker Mode

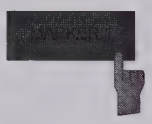
The marker mode facility allows markers to be configured either as normnal or delta markers. Normal markers show and absolute marker position, delta markers show a marker position result relative to the normal marker 1.

The *MARKER NORM DELTA* softkey toggles the currently active marker between normal and delta marker mode.

Toggle Marker Display

Markers can be toggled by pressing the Marker soft-key as follows:

Pressing the *MARKER* softkey when the marker is not displayed (softkey has grey background) causes the Marker pop-up to be displayed and the marker to be switched on. The associated marker then become the currently active marker. Pressing the *MARKER NORM DELTA* softkey then toggles the state of this marker.



Pressing the *MARKER* softkey when the Marker pop-up is displayed (softkey has red background) causes the marker to be switched off.

Pressing the *MARKER* softkey when the Marker is displayed but the Marker pop-up is not displayed (softkey has green background) causes the Marker pop-up to be displayed.

Because delta marker results are relative to marker 1, switching off marker 1 also causes all delta markers to be switched off

All markers in the active screen can be switched off by pressing the *ALL MARKER OFF* softkey

Assigning Markers to Traces

Marker can be assigned to any of the displayed traces.

Pressing the *MKR->* hardkey displays the Marker Extension softkey menu.

Fig. 2-6 Marker Extension Softkey Menu

Pressing the *SELECT MARKER* displays the Select Marker pop-up dialog. This allows a marker (1 to 4) to be selected. Selecting 0 selects delta marker 1. As soon as a marker has been selected the appropriate Marker pop-up dialog is displayed. This allows the position of the selected marker to be adjusted

Pressing the *MKR->TRACE* displays the Select Trace pop-up dialog. This allows the ID of the trace to which the currently active marker is to be attached to be supplied. The currently active marker can be selected using the *SELECT MARKER* softkey

Trace Menu

The *TRACE* hardkey brings up the Trace softkey menu. Any settings views on display when the display softkey menu is displayed shall be closed.

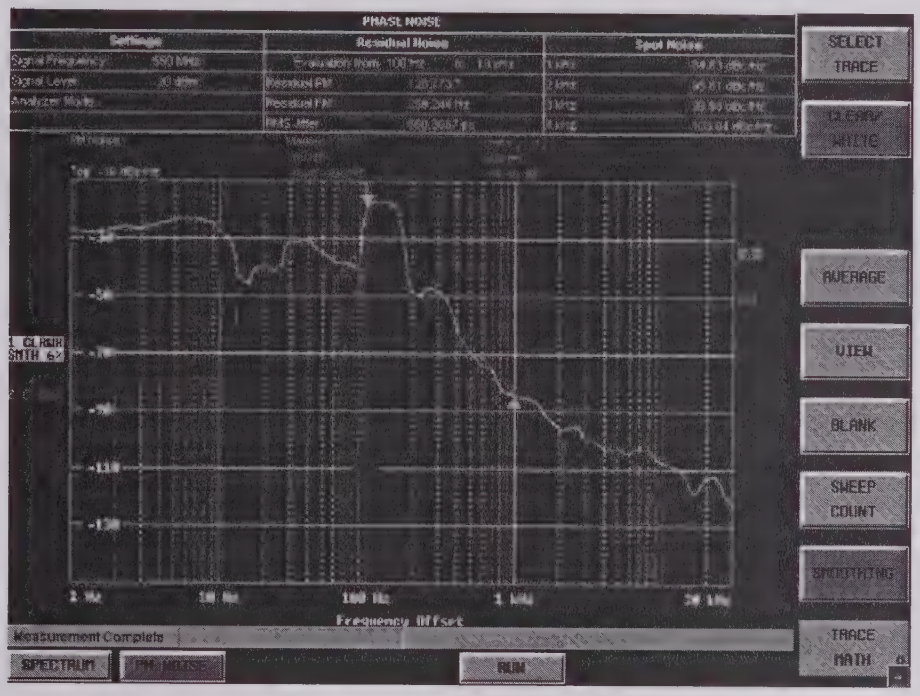
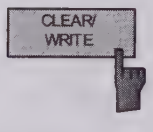


Fig. 2-7 Trace Menu

When the *SELECT TRACE* softkey is pressed, the *Select Trace* pop-up dialog is displayed. Up to 3 traces can be selected. The selected trace will be the active trace for selecting the trace mode (Clear / Write, Average, View, Blank).



The *CLEAR/WRITE* softkey activates the overwrite mode for the collected measured values for the active trace, ie the trace is overwritten by each sweep.

The *AVERAGE* softkey activates the trace averaging function for the active trace.

The averaging is performed over the requested number of sweeps for single sweep mode.

For a sweep count = 0 , a running average is calculated according to the following formula:

$$\text{TRACE} = \frac{9 * \text{TRACE} + \text{meas. value}}{10}$$

Due to the weighting between the new measured value and the trace average, past values have practically no influence on the displayed trace after about ten sweeps. With this setting, signal noise is effectively reduced

without need for restarting the averaging process after a change of the signal. If the sweep count is >1, averaging takes place over the selected number of sweeps. In this case the displayed trace is determined during averaging according to the following formula:

$$TRACE_n = 1/n \left[\sum_{i=1}^{n-1} (T_i) + \text{meas. value}_n \right]$$

where n is the number of the current sweep (n = 2 ... SWEEP COUNT). No averaging is carried out for the first sweep but the measured value is stored in the trace memory. With increasing n, the displayed trace is increasingly smoothed since there are more single sweeps for averaging.

After the selected number of sweeps the average trace is saved in the trace memory. Until this number of sweeps is reached, a preliminary average is displayed.

After completion of averaging, ie when the averaging length defined by *SWEEP COUNT* is attained, a running averaging is continued with *CONTINUOUS SWEEP* according to the following formula:

$$TRACE = \frac{(N - 1) * TRACE_{old} + \text{meas.Value}}{N}$$

Where Trace = new trace
$Trace_{old}$ = old trace
N = SWEEP COUNT

The display "N of N" does not change any more until a new start is triggered.

In the *SINGLE SWEEP* mode, the sweeps are stopped when the selected number of sweeps is attained. The number of the current sweep and the total number of sweeps are shown on the display: "3 of 200".

The *VIEW* softkey freezes the current contents of the active trace memory and displays it. If a trace is frozen by *VIEW*, the instrument settings can be changed without the displayed trace being modified.

The display settings such as Y axis and Trace Offset settings can be still changed, FS-K40 automatically adapts the measured data to the changed display range.

.

The *BLANK* softkey activates the blanking of the active trace.

The *SWEEP COUNT* softkey activates the entry of the number of sweeps used for averaging. The allowed range of values is 0 to 32767.
The default setting is 0. The number of sweeps used for averaging is the same for all active traces in the selected diagram.
Note: *The setting of the sweep count in the trace menu is equivalent to the setting in the sweep menu.*

The *SMOOTHING* softkey is ON (the softkey is green), the trace on the screen will be smoothed by the smoothing percentage (see general settings for noise). Toggling this softkey will have an immediate effect on the active trace on display. Each trace (trace1, trace2 and trace3) can be smoothed/unsmoothed individually.

The smoothing algorithm used is as follows:

$$y'(s) = 10 * Log_{10}\left(\left(\sum_{x=s-\left(\frac{n-1}{2}\right)}^{x=s+\left(\frac{n-1}{2}\right)} 10^{\left(\frac{y(x)}{10}\right)}\right) \div n\right)$$

Where: s = the trace sample number, $y(s)$ = the phase noise at sample s, x = the sample offset from s, and n = the width of the sliding window. When x exceeds the boundary samples, the boundary sample is used, i.e. if the trace has samples numbering 0 to 500 then with $n = 5$ and $s = 0$ the average is calculated as:

$$y'(0) = 10 * Log_{10}\left(\left(3 * 10^{\left(\frac{y(0)}{10}\right)} + 10^{\left(\frac{y(1)}{10}\right)} + 10^{\left(\frac{y(2)}{10}\right)}\right) \div 5\right)$$

If both trace averaging and smoothing are specified then trace smoothing is applied first, and averaging is performed on the smoothed trace.

When smoothing is applied to a trace, the original (unsmoothed) trace is still held in memory. This makes it possible to toggle between a smoothed and unsmoothed trace without the need to run a new measurement sweep.

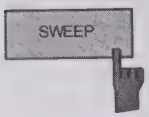
Trace Side Menu

The *ASCII FILE EXPORT* softkey stores the active trace in ASCII format on a floppy disk.
The file consists of the header containing important scaling parameters and a data section containing the trace data.
The data of the file header consist of three columns, each separated by a semicolon:
parameter name; numeric value; basic unit
The data section starts with the keyword " Trace;<n>;" (<n> = number of stored trace), followed by the measured data in two columns
which are also separated by a semicolon. The first column contains the frequency value, the second contains the corresponding Phase noise value.
This format can be read in from spreadsheet calculation programs, eg MSExcel.
It is necessary to define ';' as a separator.

Note: *Different language versions of evaluation programs may require a different handling of the decimal point. It is therefore possible to select between separators '.' (decimal point) and ',' (comma) using softkey DECIM SEP.*

The *DECIM SEP* softkey selects the decimal separator between '.' (decimal point) and ',' (comma) with floating-point numerals for the function ASCII FILE EXPORT.
With the selection of the decimal separator different language versions of evaluation programs (eg MS-Excel) can be supported.

Sweep Menu



The *SWEEP* hardkey brings up the Sweep softkey menu. Any settings views on display when the display softkey menu is displayed shall be closed.

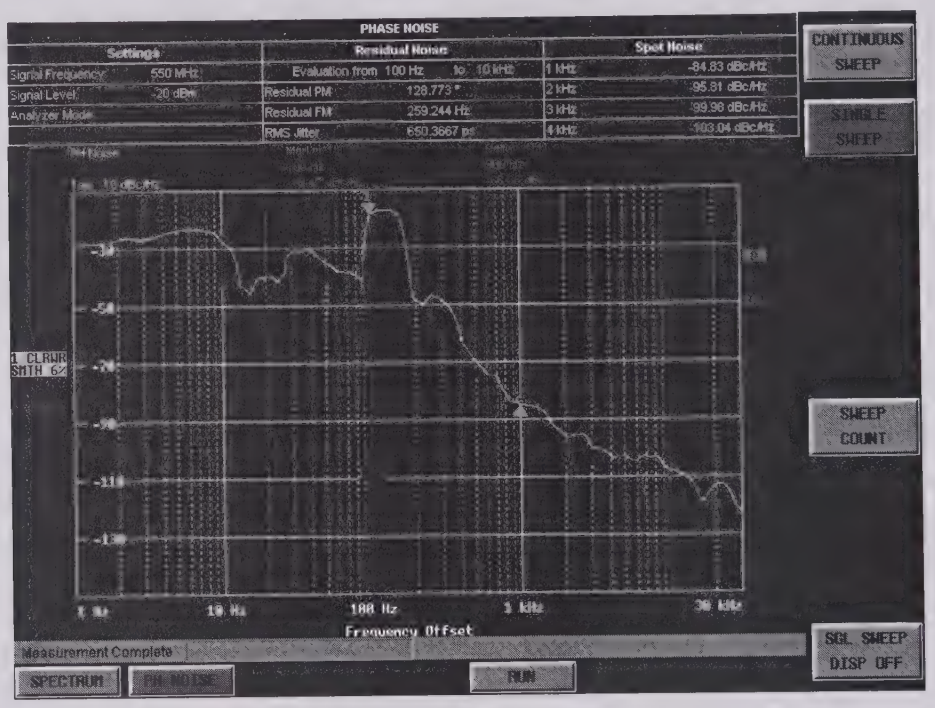
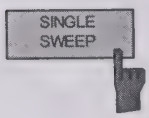


Fig. 2-8 Sweep Menu

The *CONTINUOUS SWEEP* softkey activates the continuous sweep mode. The next measurement sweep activated (using the *RUN* hotkey) will run in continuous mode



The *SINGLE SWEEP* softkey activates the single sweep mode. The next measurement sweep activated (using the *RUN* hotkey) will run in single sweep mode.

If the *SINGLE SWEEP* softkey is pressed whilst a continuous measurement is running then the measurement will abort at the end of the current sweep.

The *SWEEP COUNT* softkey activates the entry of the number of sweeps used for averaging. The allowed range of values is 0 to 32767.
In the continuous sweep mode averaging is performed until the set number of sweeps is attained and is then continued as running averaging.
The default setting is 0. The number of sweeps used for averaging is applied to all active traces.

The *SGL SWEEP DISP OFF* softkey deactivates the display while a single sweep is being performed. Once the sweep has been completed the display is reactivated.

3 Remote Control

Description of commands

This section specifies all the remote control commands specific to the R&S FS-K40 option. Only those commands provided for this option are specified. For details of remote control commands provided by the host analyzer please refer to the analyzer user manual.

Notation

In the following sections, all commands implemented in the instrument are first listed in tables and then described in detail, arranged according to the command subsystems. The notation is adapted to the SCPI standard. The SCPI conformity information is included in the individual description of the commands.

Table of Commands

Command: In the command column, the table provides an overview of the commands and their hierarchical arrangement (see indentations).

Parameter: The parameter column indicates the requested parameters together with their specified range.

Unit: The unit column indicates the basic unit of the physical parameters.

Comment: In the comment column an indication is made on:

- whether the command does not have a query form,
- whether the command has only one query form
- whether the command is implemented only with a certain option of the instrument

Indentations The different levels of the SCPI command hierarchy are represented in the table by means of indentations to the right. The lower the level, the further the indentation to the right. Please note that the complete notation of the command always includes the higher levels as well.

Example: `SENSe:FREQuency:CENTer` is represented in the table as follows:

- `SENSe` first level
  - `:FREQuency` second level
    - `:CENTer` third level

Individual description The individual description contains the complete notation of the command. An example for each command, the *RST value and the SCPI information are included as well.

Upper/lower case notation Upper/lower case letters are used to mark the long or short form of the key words of a command in the description (see Section 3.5.2). The instrument itself does not distinguish between upper and lower case letters.

Special characters | A selection of key words with an identical effect exists for several commands. These keywords are indicated in the same line; they are separated by a vertical stroke. Only one of these keywords needs to be included in the header of the command. The effect of the command is independent of which of the keywords is used.

Example: `SENSe:FREQuency:CW|:FIXed`

The two following commands with identical meaning can be created. They set the frequency of the fixed frequency signal to 1kHz:

```
SENSe:FREQuency:CW 1E3 = SENSe:FREQuency:FIXed 1E3
```

A vertical stroke in parameter indications marks alternative possibilities in the sense of "or". The effect of the command is different, depending on which parameter is used.

Example: Selection of the parameters for the command

```
DISPlay:FORMat FULL | SPLit
```

If parameter FULL is selected, full screen is displayed, in the case of SPLit, split screen is displayed.

[ ] Key words in square brackets can be omitted when composing the header (cf. Section 3.5.2, Optional Keywords). The full command length must be accepted by the instrument for reasons of compatibility with the SCPI standards. Parameters in square brackets can be incorporated optionally in the command or omitted as well.

{ } Parameters in braces can be incorporated optionally in the command, either not at all, once or several times.

Description of parameters Due to the standardisation, the parameter section of SCPI commands consists always of the same syntactical elements. SCPI has therefore specified a series of definitions, which are used in the tables of commands. In the tables, these established definitions are indicated in angled brackets (<...>) and will be briefly explained in the following (see also Section 3.5.5, "Parameters").

<Boolean> This keyword refers to parameters which can adopt two states, "on" and "off". The "off" state may either be indicated by the keyword OFF or by the numeric value 0, the "on" state is indicated by ON or any numeric value other than zero. Parameter queries are always returned the numeric value 0 or 1.

<numeric_value>

<num> These keywords mark parameters which may be entered as numeric values or be set using specific keywords (character data).The following keywords given below are permitted:

MINimum This keyword sets the parameter to the smallest possible value.

MAXimum This keyword sets the parameter to the largest possible value.

DEFault This keyword is used to reset the parameter to its default value.

UP This keyword increments the parameter value.

DOWN This keyword decrements the parameter value.
The numeric values associated to MAXimum/ MINimum/DEFault can be queried by adding the corresponding keywords to the command. They must be entered following the quotation mark.

Example: `SENSe:FREQuency:CENTer? MAXimum`

returns the maximum possible numeric value of the center frequency as result.

<arbitrary block program data>
This keyword is provided for commands the parameters of which consist of a binary data block.

SCPI Commands

ABORt Subsystem

The ABORt subsystem provide a mechanism by which running measurements can be aborted

COMMAND	PARAMETERS	UNIT	COMMENT
ABORt			

ABORt

This causes the current measurement, which is being performed, to be aborted.

Example: "ABOR" - The FS-K40 option will attempt to abort the current active measurement.

Characteristics: *RST value: --
SCPI: Conforming

Mode: FS-K40

CALCulate: Subsystem

Note for all CALCulate commands only CALCulate1 is valid in FS-K40 as FS-K40 has only a single measurement screen.

CALCulate:EVALuation Subsystem

COMMAND	PARAMETERS	UNIT	COMMENT
:CALCulate<1|2>			
:EVALuation			
[:STATe]	<boolean>		
:STARt	<numeric_value>	Hz	
:STOP	<numeric_value>	Hz	

CALCulate<1|2>:EVALuation[:STATe]

This command specifies whether Residual noise values are calculated over the entire trace or within a specified frequency range. When switched ON the residual noise values are calculated over the range specified by CALCulate<1|2>:EVALuation:STARt and CALCulate<1|2>:EVALuation:STOP. When switched OFF the results are calculated over the entire trace

Example: "CALC:EVAL 0" Specifies that residual noise is calculated over the entire trace

Characteristics: *RST value: 0

SCPI: device-specific

Mode: FS-K40

CALCulate<1|2>:EVALuation:STARt

This command specifies the start frequency for residual noise calculation when CALCulate<1|2>:EVALuation[:STATe] is switched ON. This command has no effect if CALCulate<1|2>:EVALuation[:STATe] is switched OFF

Example: "CALC:EVAL:STARt 1MHZ" Specifies that residual noise is calculated starting from 1 MHz

Characteristics: *RST value: 1 KHz

SCPI: device-specific

Mode: FS-K40

CALCulate<1|2>:EVALuation:STOP

This command specifies the stop frequency for residual noise calculation when CALCulate<1|2>:EVALuation[:STATe] is switched ON. This command has no effect if CALCulate<1|2>:EVALuation[:STATe] is switched OFF

Example: "CALC:EVAL:STOP 1 MHZ" Specifies that residual noise is calculated up to 1 MHz

Characteristics: *RST value: 1 MHz

SCPI: device-specific

Mode: FS-K40

CALCulate:LIMit Subsystem

The CALCulate:LIMit subsystem consists of the limit lines and the corresponding limit checks. The limit lines can be defined as upper or lower limit lines. The individual Y values of the limit lines correspond to the values of the X-axis (CONTrol). The number of X- and Y-values must be identical.

Up to 8 limit lines can be defined at the same time (marked by LIMIT1 to LIMIT8) in the screen
Each limit line can be assigned a name. An explanatory comment can also be given for each

Example
Definition and use of a new limit line 5 for trace in the Noise Figure trace screen with the following features:

- upper limit line
- 5 ref. values: 126 MHz/-40 dB, 127 MHz/-40 dB, 128 MHz/-20 dB, 129 MHz/-40 dB, 130 MHz/-40 dB

Definition of the line:

1. Defining the name: `CALC:LIM5:NAME 'TEST1'`
2. Entering the comment: `CALC:LIM5:COMM 'Upper limit line'`
3. Associated trace in screen A: `CALC:LIM5:TRAC 2`
4. Defining the X-axis values: `CALC:LIM5:CONT 126MHZ, 127MHZ, 128MHZ, 129MHZ, 130MHZ`
5. Defining the y values: `CALC:LIM5:UPP -40, -40, -30, -40, -40`

The definition of the safety margin and shifting in X- and/or Y-direction can take place as from here (see commands below).

Switching on and evaluating the line

1. Switching on the line `CALC:LIM5:UPP:STAT ON`
2. Switching on the limit `CALC:LIM5:STAT ON`
3. Starting a new measurement with synchronization: `INIT;*WAI`
4. Querying the limit check result: `CALC:LIM5:FAIL?`

COMMAND	PARAMETERS	UNIT	COMMENT
:CALCulate			
:LIMit<1 to8>			
:TRACe	< numeric_value >		
:STATe	<Boolean>		
:FAIL?			Query only
:CLEar			
[:IMMediate]	--		
:COMMent	<string>		
:COPY	1 to 8 | < name>		
:NAME	<string>		
:DELete	--		

CALCulate:LIMit<1 to 8>:TRACe

This command assigns a limit line to a particular trace..

Examples: "CALC:LIM2:TRAC 1" Assigns limit line 2 to the trace 1.

Characteristics: *RST value: 1

SCPI: device-specific

Mode: FS-K40

CALCulate:LIMit<1 to 8>:STATe ON | OFF

This command switches on or off the limit check for the selected limit.

The result of the limit check can be queried with CALCulate:LIMit<1 to 8>:FAIL?.

Example: "CALC:LIM:STAT ON" Switches on the limit check for limit line 1
"CALC:LIM:STAT OFF" Switches off the limit check for limit line 1

Characteristics: *RST value: OFF

SCPI: conforming

Mode: FS-K40

CALCulate:LIMit<1 to 8>:FAIL?

This command queries the result of the limit check of the indicated limit line. It should be noted that a complete sweep must have been performed for obtaining a valid result. A synchronization with *OPC, *OPC? or *WAI should therefore be provided. The result of the limit check responds with 0 for PASS and 1 for FAIL.

Example: "INIT;*WAI" Starts a new measurement and waits for its end.

"CALC:LIM3:FAIL?" Queries the result of the check for limit line 3.

Characteristics: *RST value: -

SCPI: conforming

Mode: FS-K40

CALCulate:LIMit<1 to 8>:CLEar: [:IMMediate]

This command clears the STATus:QUEStionable:LIMit event register for the selected limit line.

Example: "CALC:LIM:CLE" Clears the event register.

Characteristics: *RST value: -

SCPI: conforming

Mode: FS-K40

This command is an event and is therefore not assigned an *RST value.

CALCulate:LIMit<1 to 8>:COMMent <string>

This command defines a comment for the limit line selected.

Example: "CALC:LIM5:COMM 'Upper limit for Gain'
"Defines the comment for limit line 5.

Characteristics: *RST value: -
SCPI: device-specific

Mode: FS-K40

CALCulate:LIMit<1 to 8>:COPY 1 to 8 | <name>

This command copies one limit line onto another one.

Syntax: "CALCulate:LIMit<1 to 8>:COPY 1 to 8 | <name>"
1 to 8 = number of the new limit line or:
name = name of the new limit line given as a string

Example: "CALC:LIM1:COPY 2" Copies limit line 1 to line 2.

"CALC:LIM1:COPY 'NFIG2'" Copies limit line 1 to a new line named 'NFIG2'.

Characteristics: *RST value: -
SCPI: device-specific

Mode: FS-K40

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate:LIMit<1 to 8>:NAME <name>

This command assigns a name to a limit line numbered 1 to 8. If it does not exist already, a limit line with this name is created.

Syntax: "CALCulate:LIMit<1 to 8>:NAME <name>"
name = name of the new limit line given as a string

Example: "CALC:LIM1:NAME 'NFIG1'" Assigns the name 'NFIG1' to limit line 1.

Characteristics: *RST value: 'REM1' to 'REM8' for lines 1 to 8
SCPI: device-specific

Mode: FS-K40

CALCulate:LIMit<1 to 8>:DELete

This command deletes the selected limit line.

Example: "CALC:LIM1:DEL" Deletes limit line 1.

Characteristics: *RST value: -
SCPI: device-specific

Mode: FS-K40

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate:LIMit:CONTrol Subsystem

The CALCulate:LIMit:CONTrol subsystem defines the x-axis (CONTrol-axis).

COMMAND	PARAMETERS	UNIT	COMMENT
:CALCulate			
:LIMit<1 to 8>			
:CONTrol			
[:DATA]	<numeric_value> ...	Hz	
:SHIFt	<numeric_value>	Hz	

CALCulate:LIMit<1 to 8>:CONTrol[:DATA] <numeric_value>,<numeric_value>

This command defines the X-axis values (frequencies) of the upper or lower limit lines.

The number of values for the CONTrol axis and for the corresponding UPPer and/or LOWer limit lines have to be identical. Otherwise default values are entered for missing values or unnecessary values are deleted.

Example: "CALC:LIM2:CONT 1MHz,30MHz,100MHz, 300MHz,1GHz"
Defines 5 reference values for the X-axis of limit line 2

"CALC:LIM2:CONT?" Outputs the reference values for the X-axis of limit line 2 separated by a comma.

Characteristics: *RST value: -
SCPI: conforming

Mode: FS-K40

CALCulate:LIMit<1 to 8>:CONTrol:SHIFt <numeric_value>

This command moves a limit line by the indicated value in x direction. The line is shifted by modifying the individual x values.

Example: "CALC:LIM2:CONT:SHIF 50KHZ"
Shifts all reference values of limit line 2 by 50 kHz.

Characteristics: *RST value: -
SCPI: device-specific

Mode: FS-K40

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate:LIMit:LOWer Subsystem

The CALCulate:LIMit:LOWer subsystem defines the lower limit line. Note that if a set command is issued in this subsystem the limit line effected is automatically converted to a lower limit line.

COMMAND	PARAMETERS	UNIT	COMMENT
:CALCulate			
:LIMit<1 to 8>			
:LOWer			
[:DATA]	<numeric_value>	dB | K	
	...		
:STATe	<Boolean>	--	
:SHIFt	<numeric_value>	dB | K	

CALCulate:LIMit<1 to 8>:LOWer[:DATA] <numeric_value>,<numeric_value>...

This command defines the values for the selected lower limit line.

The number of values for the CONTrol axis and for the corresponding LOWer limit line has to be identical. Otherwise default values are entered for missing values or unnecessary values are deleted.

If the measured values are smaller than the LOWer limit line, the limit check signals errors.

Example: "CALC:LIM2:LOW -30,-40,-10,-40,-30"
Defines 5 lower limit values for limit line 2 in the preset unit.

"CALC:LIM2:LOW?" Outputs the lower limit values of limit line 2 separated by a comma.

Characteristics: *RST value: -
SCPI: conforming

Mode: FS-K40

CALCulate:LIMit<1 to 8>:LOWer:STATe ON | OFF

This command switches on or off the indicated limit line in the selected measurement window. The limit check is activated separately with CALC:LIM:STAT ON.

Example: "CALC:LIM4:LOW:STAT ON" Switches on limit line 4 (lower limit)

"CALC:LIM4:LOW:STAT OFF" Switches off limit line 4 (lower limit)

Characteristics: *RST value: -
SCPI: conforming

Mode: FS-K40

CALCulate:LIMit<1 to 8>:LOWer:SHIFt <numeric_value>

This command shifts a limit line by the indicated value in Y-direction. The line is shifted by modifying the individual y values

Example: "CALC:LIM3:LOW:SHIF 20DB" Shifts all Y values of limit line 3 by 20 dB.

Characteristics: *RST value: -
SCPI: device-specific

Mode: FS-K40

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate:LIMit:UPPer Subsystem

The CALCulate:LIMit:UPPer subsystem defines the upper limit line. Note that if a set command is issued in this subsystem the limit line effected is automatically converted to an upper limit line.

COMMAND	PARAMETERS	UNIT	COMMENT
:CALCulate			
LIMit<1 to 8>			
:UPPer			
[:DATA]	<numeric_value> ...	DB | K	
:STATe	<Boolean>		
:SHIFt	<numeric_value>	DB | K	

CALCulate:LIMit<1 to 8>:UPPer[:DATA] <numeric_value>,<numeric_value>...

This command defines the values for the upper limit lines independently of the measurement window.

The number of values for the CONTrol axis and for the corresponding UPPer and/or LOWer limit line have to be identical. Otherwise default values are entered for missing values or unnecessary values are deleted.

The unit must be identical with the unit selected by `CALC:LIM:UNIT`. If no unit is indicated, the unit defined with `CALC:LIM:UNIT` is automatically used.

Example: "`CALC:LIM2:UPP -10,0,0,-10,-5`" Defines 5 upper limit values for limit line 2 in the preset unit.

"`CALC:LIM2:UPP?`" Outputs the upper limit values for limit line 2 separated by a comma.

Characteristics: *RST value: -
SCPI: conforming

Mode: FS-K40

CALCulate:LIMit<1 to 8>:UPPer:STATe ON | OFF

This command switches on or off the indicated limit line. The limit check is activated separately with `CALC:LIM:STAT ON`

Example: "`CALC:LIM4:UPP:STAT ON`" Switches on limit line 4 (upper limit)

Characteristics: *RST value: -
SCPI: conforming

Mode: FS-K40

CALCulate:LIMit<1 to 8>:UPPer:SHIFt <numeric_value>

This command moves a limit line by the indicated value in Y-direction. The line is shifted by modifying the individual y values

Example: "`CALC:LIM3:UPP:SHIF 20DB`" Shifts all Y values of limit line 3 by 20 dB.

Characteristics: *RST value: -
SCPI: device-specific

Mode: FS-K40

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate:DELTamarker Subsystem

The CALCulate:DELTamarker subsystem checks the delta marker functions in the FS-K40 option.

Note that for all delta marker commands the suffix for the CALCulate must be 1

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
DELTamarker <1 to 4>			
:TRACe	<numeric_value>		
:X	<numeric_value>	HZ	
:Y	<numeric_value>		
: AOFF			no query
[:STATe]	<Boolean>		

CALCulate<1|2>:DELTamarker<1 to 4>:TRACe

This command assigns the selected delta marker to the indicated measurement curve in the selected measurement window.

Example: "CALC1:DELT:TRAC 2" Assigns marker 1 in screen A to trace 2.
"CALC2:MARK:TRAC 5" Assigns marker 1 in screen B to trace 5.

Characteristics: *RST value: 1
SCPI: device-specific

Mode: FS-K40

CALCulate<1|2>:DELTamarker<1 to 4>:X

This command positions the selected delta marker to the indicated frequency or time in the selected measurement window.

Example: "CALC1:DELT:X 2MHZ" Positions marker 1 in screen A to time 2 MHz.

Characteristics: *RST value: -
SCPI: device-specific

Mode: FS-K40

CALCulate<1|2>:DELTamarker<1 to 4>:Y

This command positions the selected delta marker to the indicated Y position in the selected measurement window. The units for this command are dBc/Hz.

Example: "CALC1:DELT:Y?" Outputs the measured value of marker 1 in screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: FS-K40

CALCulate<1|2>:DELTamarker<1 to 4>:AOFF

This command switches off all active delta markers in the specified measurement window.

Example: "CALC1:DELT:AOFF" 'Switches off all delta markers in the screen A window.

Characteristics: *RST value: -
SCPI: device-specific

Mode: FS-K40

CALCulate<1|2>:DELTamarker<1 to 4>:STATe

This command switches on or off the currently selected delta marker in the selected measurement window. If no indication is made, marker 1 is selected automatically. If marker 2, 3 or 4 is selected and used as a marker, it is switched to delta marker mode.

Example: "CALC1:DELT:STATE ON" Switches the screen A marker ON.

Characteristics: *RST value: 1
SCPI: device-specific

Mode: FS-K40

CALCulate:MARKer Subsystem

The CALCulate:MARKer subsystem checks the marker functions in the FS-K40 option.

Note that for all marker commands the suffix for the CALCulate must be 1.

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
MARKer<1 to 4>			
:TRACe	<numeric_value>		
:X	<numeric_value>	HZ	
:Y	<numeric_value>		
: AOFF			no query
[:STATe]	<Boolean>		

CALCulate<1|2>:MARKer<1 to 4>:TRACe

This command assigns the selected marker to the indicated measurement curve in the selected measurement window.

Example: "CALC1:MARK:TRAC 2" Assigns marker 1 in screen A to trace 2.

Characteristics: *RST value: 1
SCPI: device-specific

Mode: FS-K40

CALCulate<1|2>:MARKer<1>:X

This command positions the selected marker to the indicated frequency in the selected measurement window.

Example: "CALC:MARK:X 2MHZ" Positions marker 1 in screen A to time 2MHz.

Characteristics: *RST value: -
SCPI: device-specific

Mode: FS-K40

CALCulate<1|2>:MARKer<1 to 4>:Y

This command positions the selected marker to the indicated Y position in the selected measurement window. The units for this command are dBc/Hz.

Example: "CALC:MARK:Y?" Outputs the measured value of marker 1 in screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: FS-K40

CALCulate<1|2>:MARKer<1 to 4>:AOFF

This command switches off all active markers in the specified measurement window. The window will either be “screen a” or “screen b” and will be determined by the numeric value that follows the “CALCulate” keyword.

Example: `"CALC1:MARK:AOFF"` 'Switches off all markers in the screen A window.

Characteristics: *RST value: -
SCPI: device-specific

Mode: FS-K40

CALCulate<1|2>:MARKer<1 to 4>:STATe

This command switches on or off the currently selected marker in the selected measurementwindow. If no indication is made, marker 1 is selected automatically. If marker 2, 3 or 4 is selectedand used as a delta marker, it is switched to marker mode.

Example: `"CALC1:MARK1:STATE ON"` Switches the screen A marker ON.

Characteristics: *RST value: 1
SCPI: device-specific

Mode: FS-K40

CALCulate:SNOise Subsystem

The CALCulate:SNOise subsystem allows spot noise measurement points to be set, and results returned.

Note that for all spot noise commands the suffix for the CALCulate must be 1.

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
SNOise<1 to 5>			
:X	<numeric_value>	HZ	
:Y	<numeric_value>		query only
: AOFF			
[:STATe]	<Boolean>		

CALCulate<1|2>:SNOise<1>:X

This command positions the selected sot noise marker to the indicated frequency

Example: "CALC1:SNO:X 2MHz" Positions spot noise marker 1 in screen A to time 2 MHz.

Characteristics: *RST value: -
SCPI: device-specific

Mode: FS-K40

CALCulate<1|2>:SNOise<1 to 4>:Y

This command returns the measured spot noise marker result in the selected measurement window. The units for this command are dBc/Hz.

Example: "CALC1:SNO:Y?" Outputs the measured value of spot noise marker 1 in screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: FS-K40

CALCulate<1|2>:SNOise<1 to 4>:AOFF

This command switches off all active spot noise markers in the specified measurement window.

Example: " CALC1:SNO:AOFF" 'Switches off all spot noise markers in the screen A window.

Characteristics: *RST value: -
SCPI: device-specific

Mode: FS-K40

CALCulate<1|2>:SNOise<1 to 4>:STATe

This command switches on or off the currently selected spot noise marker in the selected measurement window. If no indication is made, marker 1 is selected automatically.

Example: "CALC1:SNO1:STATE ON" Switches the screen A marker ON.

Characteristics: *RST value: 1
SCPI: device-specific

Mode: FS-K40

CONFigure Subsystem

The CONFigure subsystem contains commands for configuring complex measurement tasks. The CONFigure subsystem is closely linked to the functions of the FETCH subsystem, where the measurement results of the measurements are queried.

COMMAND	PARAMETERS	UNIT	COMMENT
CONFigure :POWer :EXPected :RF :AUTO	 <numeric_value> <boolean>	 DBM	

CONFigure:POWer:EXPected:RF

This remote control command is used to specify the input power level of the source signal as supplied to the Analyzer RF input.

Example: "CONF:POW:EXP:RF 9" The FS-K40 option assumes an input signal strength of 9 dBm

Characteristics: *RST value: 0
SCPI: Device Specific

Mode: FS-K40

CONFigure:POWer:AUTO

This remote control command is used to switch on or off automatic power level detection. When switched on, power level detection is performed at the start of each measurement sweep.

Example: "CONF:POW:AUTO 1" The FS-K40 option will automatically detect the input power level

Characteristics: *RST value: 1
SCPI: Device Specific

Mode: FS-K40

DISPlay Subsystem

The DISPLay subsystem controls the selection and presentation of textual and graphic information as well as of measurement data on the display.

COMMAND	PARAMETERS	UNIT	COMMENT
:DISPLAY			
[:WINDow<1|2>]			
:TRACe<1...3>			
:Y			
[:SCALe]	<numeric_value>	DBM	
:AUTO	<boolean> | ONCE		
:RLEVel	<numeric_value>	DB	
:OFFSet	<numeric_value>	DB	
:SMOothing			
[:STATe]	<boolean>		
:APERture	<numeric_value>	PCT	
:MODE	WRITe|VIEW|AVERage|		
[:STATe]	<boolean>		

DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]

This command defines the display range of the Y-axis (level axis) in the selected measurement window. The numeric suffix in TRACe<1 to 3> is irrelevant.

Example: "DISP:WIND:TRAC:Y?" Returns the current Y Axis range in use

Characteristics: *RST value: 100 dB
SCPI: Device Specific

Mode: FS-K40

DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:AUTO

This command switches automatic scaling for the Y axis on and off. Using the ONCE setting with this command causes automatic scaling to be performed immediately, regardless of whether automatic scaling is switched on.
The numeric suffix at WINDow<1|2> and TRACe<1 to 3> are irrelevant.

Example: "DISP:WIND:TRAC:Y:SCAL:AUTO 1" Switches on automatic Y axis scaling

Characteristics: *RST value: 1
SCPI: Device Specific

Mode: FS-K40

DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RLEVel

This command specifies the current internal instrument reference level used when performing measurements.

The numeric suffix at WINDow<1|2> and TRACe<1 to 3> are irrelevant.

Example: "DISP:TRAC:Y:RLEV?" Returns the current reference level in use

Characteristics: *RST value: -
SCPI: Device Specific

Mode: FS-K40

DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RLEVel:OFFSet

This remote control command specifies the external attenuation/gain applied to measurements. The value corresponds to the reference level offset in spectrum analyzer mode.
The numeric suffix at WINDow<1|2> and TRACe<1 to 3> are irrelevant.

Example: "DISP:TRAC:Y:RLEV:OFFS 10" external attenuation (level offset) of the analyzer is 10dB

Characteristics: *RST value: 0 dB
SCPI: conforming

Mode: FS-K40

DISPlay[:WINDow<1|2>]:TRACe<1...3>:SMOothing[:STATe]

This remote control command specifies whether smoothing of a particular trace is carried out.
The numeric suffix at WINDow<1|2> is irrelevant

Example: "DISP:TRAC1:SMO 1" Specifies that smoothing of trace 1 is to be performed

Characteristics: *RST value: OFF
SCPI: conforming

Mode: FS-K40

DISPlay[:WINDow<1|2>]:TRACe<1...3>:SMOothing:APERture

This remote control command specifies the aperture of the window to be used when trace smoothing is performed.
A single aperture applies to all traces which require smoothing and as such the numeric suffix at WINDow<1|2> and TRACe<1 to 3> are irrelevant

Example: "DISP:TRAC1:SMO:APER 1" sets that smoothing window for trace 1 to 1%

Characteristics: *RST value: OFF
SCPI: conforming

Mode: FS-K40

DISPlay[:WINDow<1|2>]:TRACe<1...3>:MODE

This command defines the type of display and the evaluation of the traces in the selected measurement window. WRITE corresponds to the Clr/Write mode of manual operation.
The trace is switched off (= BLANK in manual operation) with `DISP:WIND:TRAC:STAT OFF`.
The number of measurements for AVERage is defined with the command `SENSe:SWEep:COUNt`. It should be noted that synchronization to the end of the indicated number of measurements is only possible in single sweep mode.

Example: "DISP:TRAC1:MODE WRIT" Sets trace 1 to clear/write mode

Characteristics: *RST value: WRITe for trace 1, STATe OFF for trace 2 & 3
SCPI: conforming

Mode: FS-K40

DISPlay[:WINDow<1|2>]:TRACe<1...3>[:STATe]

This command switches on or off the display of the corresponding trace in the selected measurement window.

Example: "DISP:TRAC1 0" Switches OFF trace 1

Characteristics: *RST value: ON for trace 1, OFF for trace 2 & 3
SCPI: conforming

Mode: FS-K40

FETCh Subsystem

The FETCh subsystem contains commands for reading out results of complex measurement tasks. This subsystem is closely linked to the CONFigure and SENSe subsystems.

COMMAND	PARAMETERS	UNIT	COMMENT
FETCh			
:PNOise			
:RFM?		--	query only
:RPM?		--	query only
:RMS?		--	query only

FETCh:PNOise:RFM?

This command returns the measured Residual FM result.

Example: "FETC:PNO:RFM?" Returns the Residual FM result.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: FS-K40

FETCh:PNOise:RPM?

This command returns the measured Residual PM result.

Example: "FETC:PNO:RPM?" Returns the Residual PM result.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: FS-K40

FETCh:PNOise:RMS?

This command returns the measured Residual RMS result.

Example: "FETC:PNO:RMS?" Returns the Residual RMS result.

Characteristics: *RST value: -
SCPI: Device Specific

Mode: FS-K40

FORMat Subsystem

The FORMat subsystem provide specifies the data format of the data transmitted from and to the instrument

COMMAND	PARAMETERS	UNIT	COMMENT
FORMat [:DATA] :DEXPort :DSEParator	ASCii|REAL|UINT[,<numeric_value>] POINt|COMMa	-	

FORMat[\:DATA] ASCii | REAL| UINT [, 8 | 32]

This command specifies the data format for the data transmitted to from the instrument to the control PC.

Example: "FORM UINT,8" The data requested by the TRACE:DATA? command as unsigned integers in binary format.

Characteristics: *RST value: ASCii
SCPI: Conforming

Mode: FS-K40

FORMat[\:DATA]:DEXPort:DSEParator POINt | COMMa

This command defines which decimal separator (decimal point or comma) is to be used for outputting measurement data to the file in ASCII format. Different languages of evaluation programs (eg MS-Excel) can thus be supported.

Example: "FORM:DEXP:DSEP POIN" Sets the decimal point as separator.

Characteristics: *RST value: POINt
SCPI: device-specific

Mode: FS-K40

INITiate Subsystem

The INITiate subsystem configures the instrument prior to a measurement being carried out. It is basically used to tell the instrument which measurement is to be performed and takes any necessary step to set up the instrument for the measurement.

COMMAND	PARAMETERS	UNIT	COMMENT
INITiate			
[:IMMediate]			no query
:CONTinuous	<Boolean>		no query
:DISPlay	<Boolean>		

INITiate[:IMMediate]

This remote control command requests the FS-K40 option to start a new measurement sequence. If a measurement sequence is already in progress, then the command will be ignored.

Example: "INIT" - The FS-K40 option will attempt to start a new measurement.

Characteristics: *RST value: -
SCPI: Conforming

Mode: FS-K40

INITiate:CONTinuous

This command determines whether the trigger system is continuously initiated (continuous) or performs single measurements (single).

Example: "INIT:CONT OFF" The FS-K40 option will attempt a non continuous measurement when initiated.

Characteristics: *RST value: -
SCPI: Conforming

Mode: FS-K40

INITiate:DISPlay

This command configures the behaviour of the display during a single sweep.

`INITiate:DISPlay OFF` means that the display is switched off during the measurement,

`INITiate:DISPlay ON` means that the display is switched on during the measurement.

The numeric suffix of INITiate is irrelevant with this command.

Example: "INIT:DISP OFF" The display is switched off during single measurements

Characteristics: *RST value: -
SCPI: Conforming

Mode: FS-K40

INSTrument Subsystem

COMMAND	PARAMETERS	UNIT	COMMENT
INSTrument			
:SELect	PNOise		
:NSElect	<numeric_value>		

INSTrument:SELect

This remote control command selects active operation of the R&S FS-K40 option by specifying its name.

Example: "INST:SEL PNOise" The R&S FS-K40 option will be selected as the active option.

Characteristics: *RST value: SAN
SCPI: Device Specific

Mode: Analyzer Base System

INSTrument:NSELect

This remote control command selects active operation of the R&S FS-K40 option by specifying its associated option number.

Example: "INST:NSEL 20" The R&S FS-K40 option will be selected as the active option.

Characteristics: *RST value: 1
SCPI: Device Specific

Mode: Analyzer Base System

SENSe Subsystem

The SENSe command is used to set and get the values of parameters in the remote instrument. The get variant of the SENSe command differs from set in that it takes no parameter values (unless otherwise stated) but is followed by the character '?' and will return the parameter's value in the same format as it is set.

e.gSENS:FREQ 10GHZ–sets the frequency to 10 GHz
SENS:FREQ? - response 10GHZ - returns the current frequency

COMMAND	PARAMETERS	UNIT	COMMENT
:[:SENSe]			
:BWidth			
[:RESolution]			
:RATio	<numeric_value>	PCT	
:TYPE	NORMal | FFT		
:FREQuency			
:CENTer	<numeric_value>	Hz	
:STARt	<numeric_value>	Hz	
:STOP	<numeric_value>	Hz	
:VERify			
[:STATe]	<Boolean>		
:TOLerance	<numeric_value>	Hz | PCT	
:LIST			
:RANGe<1..18>			
:BWidth			
[:RESolution]	<numeric_value>	Hz	
:FILTer			
:TYPe	NORMal | FFT		
:SWEep			
:COUNt	<numeric_value>		
:POWer			
:RLEVel			
VERify			
[:STATe]	<Boolean>		
:TOLerance	<numeric_value>	DB	
:SWEep			
:COUNt	<numeric_value>		
:FORWard	<Boolean>		
:MODe	FAST | NORMal | AVERaged | MANual		
:TIME	<numeric_value>	S	query only
:POINts	<numeric_value>		

[SENSe]:BANDwidth|BWIDth[:RESolution]:RATio

The remote control command is used to specify the RBW value to be used for each sub span as a ratio of the start frequency of the sub span. A value of 10% specifies that the RBW should be set to 10% of the start frequency value. If the required RBW value is no valid then the nearest RBW value will be set.

Example: "SENS:BWID:RAT 1PCT" Sets the RBW ratio to 1% of the start frequency

Characteristics: *RST value: 10 PCT
SCPI: conforming

Mode: FS-K40

[SENSe]:BANDwidth|BWIDth[:RESolution]:TYPE

The remote control command is used to specify whether to use the FFT Resolution Filter or the conventional filter for each decade

Example: "SENS:BWID:TYPE FFT"Sets the RBW to use FFT filtering

Characteristics: *RST value: FFT
SCPI: conforming

Mode: FS-K40

[SENSe]:FREQuency:CENTer

The remote control command is used to specify the frequency that the Analyzer will use to make measurements against the input signal.

Example: "SENS:FREQ:CENT 50MHZ"The FS-K40 option uses the specified frequency value to set the analyzer detection frequency.

Characteristics: *RST value: From Spectrum Analyzer
SCPI: conforming

Mode: FS-K40

[SENSe]:FREQuency:STARt

The remote control command is used to specify the start frequency for a phase noise measurement.

Example: "SENS:FREQ:STARt 3KHZ"Sets the start frequency for a phase noise measurement to 3 KHz

Characteristics: *RST value: 1 KHz
SCPI: conforming

Mode: FS-K40

[SENSe]:FREQuency:STOp

The remote control command is used to specify the stop frequency for a phase noise measurement.

Example: "SENS:FREQ:STOP 3MHZ" Sets the start frequency for a phase noise measurement to 3 MHz

Characteristics: *RST value: 1 MHz
SCPI: conforming

Mode: FS-K40

[SENSe]:FREQuency:VERify[:STATe]

The remote control command is used to specify whether frequency and level verification are to be performed before a phase noise measurement.

This command is synonymous with [SENSe]:POWer:RLEVel:VERify[:STATe]

Example: "SENS:FREQ:VER 1" Specifies that frequency and level verification is to be performed

Characteristics: *RST value: 1
SCPI: conforming

Mode: FS-K40

[SENSe]:FREQuency:VERify:TOLerance

The remote control command is used to specify the frequency tolerance for the verification of the signal. If the signal frequency varies from the specified centre frequency by a value greater than the tolerance then the verification will fail.

The setting for this parameter only has an effect if the [SENSe]:FREQuency:VERify:STATe or [SENSe]:POWer:RLEVel:VERify:STATe command is set to ON.

If the [SENSe]:SWEEP:FORWard command is set to ON then the tolerance is specified in Hz. If the [SENSe]:SWEEP:FORWard command is set to OFF then the tolerance is specified in %

Example: "SENS:FREQ:TOLerance 1KHZ" Sets the frequency tolerance for the verification measurement to 1 KHz

Characteristics: *RST value: 1 PCT
SCPI: conforming

Mode: FS-K40

[SENSe]:LIST:RANGe<1..18>:BANDwidth[:RESolution]

This command selects the resolution bandwidth (RBW) for the specified sub-band

Example: "SENS:LIST:RANG2:BAND 10KHZ" Sets the RBW to 10 KHz

Characteristics: *RST value: sub-band dependent
SCPI: conforming

Mode: FS-K40

[SENSe]:LIST:RANGe<1..18>:FILTer:TYPE

This command selects filter type for the specified sub-band

Example: "SENS:LIST:RANG2:FILT:TYPE FFT" Sets the filter to FFT mode

Characteristics: *RST value: sub-band dependent
SCPI: conforming

Mode: FS-K40

[SENSe]:LIST:RANGe<1..18>:SWEep:COUNt

This command selects sweep count for the specified sub-band

Example: "SENS:LIST:RANG2:SWE:COUN 1" Sets the sweep count to 1

Characteristics: *RST value: sub-band dependent
SCPI: conforming

Mode: FS-K40

[SENSe]:POWer:RLEVel:VERify[:STATe]

The remote control command is used to specify whether frequency and level verification are to be performed before a phase noise measurement.
This command is synonymous with [SENSe]:FREQuency:VERify[:STATe]

Example: "SENS:POW:RLEV:VER 1" Specifies that frequency and level verification is to be performed

Characteristics: *RST value: 1
SCPI: conforming

Mode: FS-K40

[SENSe]:POWer:RLEVel:VERify:TOLerance

The remote control command is used to specify the power tolerance for the verification of the signal. If the signal level varies from the specified level by a value greater than the tolerance then the verification will fail.
The setting for this parameter only has an effect if the [SENSe]:FREQuency:VERify:STATe or [SENSe]:POWer:RLEVel:VERify:STATe command is set to ON.

Example: "SENS:POW:RLEV:TOLerance 5DB" Sets the level tolerance for the verification measurement to 1 dB

Characteristics: *RST value: 10 dB
SCPI: conforming

Mode: FS-K40

[SENSe]:SWEep:FORWard

The remote control command specifies the sweep direction. When switched on the sweep direction is from the start frequency to the stop frequency. When switched off the sweep direction is reversed

Example: "SENS:SWEep:FORWard 1" The sweep direction is set to sweep from start to stop frequency

Characteristics: *RST value: 0
SCPI: conforming

Mode: FS-K40

[SENSe]:SWEep:TIME

The remote control command is used obtain the estimated measurement time.

Example: "SENS:SWEep:TIME?" Obtains the estimated measurement time.

Characteristics: *RST value: -
SCPI: conforming

Mode: FS-K40

[SENSe]:SWEep:COUNt

The remote control command is used to specify the number of sweeps.

Example: "SENS:SWEep:COUNt 64" Sets the number of sweeps to 64.

Characteristics: *RST value: 1
SCPI: conforming

Mode: FS-K40

[SENSe]:SWEep:MODe

The remote control command specifies the general sweep mode for the measurement. The sweep mode is used to set the RBW, Average and FFT settings for each sub-sweep to specific values. When the sweep mode is set to MANual then the sub-sweep settings may be speciifed

Example: "SENS:SWEep:MODe FAST" Sets the sweep mode such that each sub-sweep is executed as fast as possible.

Characteristics: *RST value: MANual
SCPI: conforming

Mode: FS-K40

STATus Subsystem

The STATus subsystem contains the commands for the status reporting system (See Section Status reporting registers). *RST does not influence the status registers.

COMMAND	PARAMETERS	UNIT	COMMENT
:			
:QUEStionable			
:LIMit<1|2>			
[:EVENt]?	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	
:POWer			
[:EVENt]?	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	
:PNOise			
[:EVENt]?	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	

STATus:QUEStionable:LIMit<1|2>[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:LIMit Register for screen A and B. Readout deletes the contents of the EVENt section.

Example: "STAT:QUES:LIM?"

Characteristics: *RST value: 0
SCPI: Device Specific

Mode: FS-K40

STATus:QUEStionable:LIMit<1|2>:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:LIMit register for screen A and B. Readout does not delete the contents of the CONDition section.

Example: "STAT:QUES:LIM:COND?"

Characteristics: *RST value: 0
SCPI: Conforming

Mode: FS-K40

STATus:QUEStionable:LIMit<1|2>:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable:LIMit register for screen A and B. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Example: "STAT:QUES:LIM:ENAB 65535" All events bits will be represented in the LIMit summary bit.

Characteristics: *RST value: 65535
SCPI: Device Specific

Mode: FS-K40

STATus:QUEStionable:LIMit<1|2>:PTRansition

This command determines what bits in the STATus:QUEStionable:LIMit Condition register of screen A or B will set the corresponding bit in the STATus:QUEStionable:LIMit Event register when that bit has a positive transition (0 to 1).The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Example: "STAT:QUES:LIMit:PTR 65535" All condition bits will be summarised in the Event register when a positive transition occurs.

Characteristics: *RST value: 65535
SCPI: Device Specific

Mode: FS-K40

STATus:QUEStionable:LIMit<1|2>:NTRansition

This command determines what bits in the STATus:QUEStionable:LIMit Condition register of screen A or B will set the corresponding bit in the STATus:QUEStionable:LIMit Event register when that bit has a negative transition (1 to 0).The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Example: "STAT:QUES:LIM:NTR 65535" All condition bits will be summarised in the Event register when a positive transition occurs.

Characteristics: *RST value: 0
SCPI: Device Specific

Mode: FS-K40

STATus:QUEStionable:POWer[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:POWer

Register. Readout deletes the contents of the EVENt section.

Example: "STAT:QUES:POW?"

Characteristics: *RST value: 0
SCPI: Device Specific

Mode: FS-K40

STATus:QUEStionable:POWer:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:POWer register. Readout does not delete the contents of the CONDition section.

Example: "STAT:QUES:POW:COND?"

Characteristics: *RST value: 0
SCPI: Conforming

Mode: FS-K40

STATus:QUEStionable:POWer:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable:POWer register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Example: "STAT:QUES:POW:ENAB 65535" All events bits will be represented in the POWer summary bit.

Characteristics: *RST value: 65535
SCPI: Device Specific

Mode: FS-K40

STATus:QUEStionable:POWer:PTRansition

This command determines what bits in the STATus:QUEStionable:POWer Condition register will set the corresponding bit in the STATus:QUEStionable:POWer Event register when that bit has a positive transition (0 to 1).The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Example: "STAT:QUES:POWer:PTR 65535" All condition bits will be summarised in the Event register when a positive transition occurs.

Characteristics: *RST value: 65535
SCPI: Device Specific

Mode: FS-K40

STATus:QUEStionable:POWer:NTRansition

This command determines what bits in the STATus:QUEStionable:POWer Condition will set the corresponding bit in the STATus:QUEStionable:POWer Event register when that bit has a negative transition (1 to 0).The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Example: "STAT:QUES:POW:NTR 65535" All condition bits will be summarised in the Event register when a positive transition occurs.

Characteristics: *RST value: 0
SCPI: Device Specific

Mode: FS-K40

STATus:QUEStionable:POWer[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:POWer Register. Readout deletes the contents of the EVENt section.

Example: "STAT:QUES:POW?"

Characteristics: *RST value: 0
SCPI: Device Specific

Mode: FS-K40

STATus:QUEStionable:PNOise:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:PNOIse register. Readout does not delete the contents of the CONDition section.

Example: "STAT:QUES:PNOI:COND?"

Characteristics: *RST value: 0
SCPI: Conforming

Mode: FS-K40

STATus:QUEStionable:PNOise:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable:PNOIse register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Example: "STAT:QUES:PNOI:ENAB 65535" All events bits will be represented in the PNOIse summary bit.

Characteristics: *RST value: 65535
SCPI: Device Specific

Mode: FS-K40

STATus:QUEStionable:PNOise:PTRansition

This command determines what bits in the STATus:QUEStionable:PNOIse Condition register will set the corresponding bit in the STATus:QUEStionable:PNOIse Event register when that bit has a positive transition (0 to 1).The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Example: "STAT:QUES:PNOi:PTR 65535" All condition bits will be summarised in the Event register when a positive transition occurs.

Characteristics: *RST value: 65535
SCPI: Device Specific

Mode: FS-K40

STATus:QUEStionable:PNOise:NTRansition

This command determines what bits in the STATus:QUEStionable:PNOIse Condition will set the corresponding bit in the STATus:QUEStionable:PNOIse Event register when that bit has a negative transition (1 to 0).The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Example: "STAT:QUES:PNOi:NTR 65535" All condition bits will be summarised in the Event register when a positive transition occurs.

Characteristics: *RST value: 0
SCPI: Device Specific

Mode: FS-K40

TRACe Subsystem

The TRACe subsystem controls access to the instrument's internal trace memory.

COMMAND	PARAMETERS	UNIT	COMMENT
TRACe [:DATA]	TRACE1 | TRACE2 | TRACE3		Query only

TRACE[:DATA]

This command returns all the measured data that relates to the currently selected measurement type. The data is returned as a comma separated list of sequential Phoise Noise trace results.

Example: "TRAC:DATA? TRACE1" The measurement data for the selected graph is returned.

Characteristics: *RST value: -
SCPI: conforming

Mode: FS-K40

Status reporting registers

The status reporting system (see Fig. 3-1) stores all information on the present operating state of the instrument, e.g. that the instrument presently carries out a calibration and on errors which have occurred. This information is stored in the status registers and in the error queue. The status registers and the error queue can be queried via IEC bus.

The information is of a hierarchical structure. The register status byte (STB) defined in IEEE 488.2 and its associated mask register service request enable (SRE) form the uppermost level. The STB receives its information from the standard event status register (ESR) which is also defined in IEEE 488.2 with the associated mask register standard event status enable (ESE) and registers STATus:OPERation and STATus:QUEStionable which are defined by SCPI and contain detailed information on the instrument.

The IST flag ("Individual STatus") and the parallel poll enable register (PPE) allocated to it are also part of the status reporting system. The IST flag, like the SRQ, combines the entire instrument status in a single bit. The PPE fulfils the same function for the IST flag as the SRE for the service request.

The output buffer contains the messages the instrument returns to the controller. It is not part of the status reporting system but determines the value of the MAV bit in the STB and thus is represented in

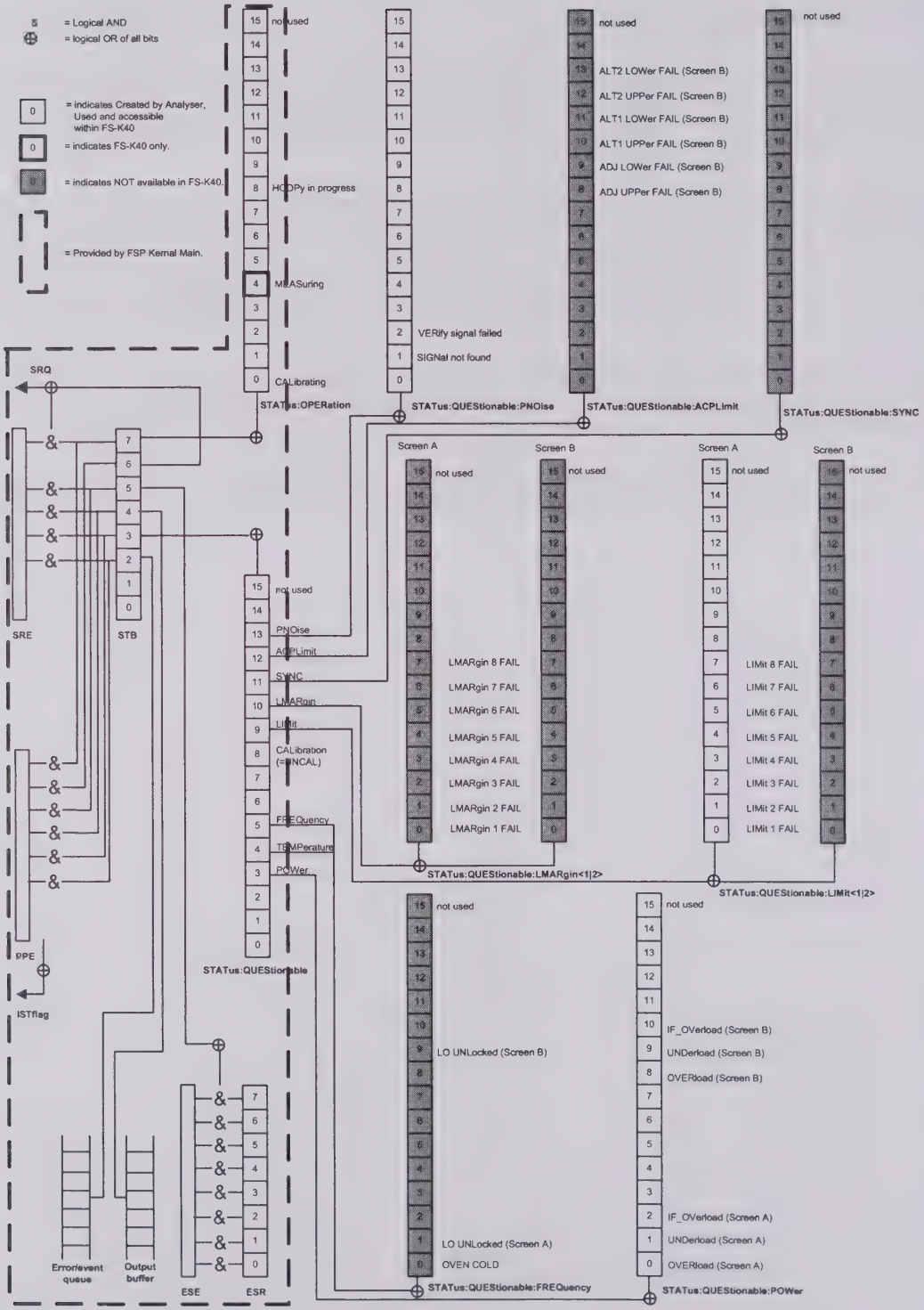


Fig. 3-1 Overview of the status registers

Description of the Status Registers

All the status registers shown in Fig. 3-1 are the same as those provided by the base system, with the exception of the following:

STATus:OPERation – Although this register is provided by R&S FSP Kernel main, R&S FS-K40 makes use of bit 4 in this register which are not used within R&S FSP Kernel main
STATus:QUESTionable:ACPLimit – This register is provided by the analyser and is not available from the R&S FS-K40 command tree
STATus:QUESTionable:LIMit2 – This register is provided by the analyser and is not available from the R&S FSQ-K40 command tree
STATus:QUESTionable:LMARgin<1|2> – These registers are provided by the analyser and are not available from the R&S FSQ-K40 command tree
STATus:QUESTionable:SYNC – This registers is provided by the analyser and is not available from the R&S FSQ-K40 command tree

The deviations from the status register structure of the base system are detailed below.

STATus:OPERation Register

In the CONDition part, this register contains information on which actions the instrument is being executing or, in the EVENt part, information on which actions the instrument has executed since the last reading. It can be read using commands "`STATus:OPERation:CONDition?`" or "`STATus:OPERation[:EVENt]?`".

Bit No	Meaning
0 to 3	These bits are not used
4	**MEASuring** A '1' in this bit position indicates that a measurement is in progress. **R&S FS-K40 only**
5 to 7	These bits are not used
8	**HardCOPy in progress** This bit is set while the instrument is printing a hardcopy.
9 to 14	These bits are not used
15	This bit is always 0

STATus:QUEStionable Register

This register comprises information about indefinite states which may occur if the unit is operated without meeting the specifications. It can be queried by commands `STATus:QUEStionable:CONDition?` and `STATus:QUEStionable[:EVENt]?`.

Bit No	Meaning
0 to 2	These bits are not used
3	**POWer** This bit is set if a questionable power occurs
4	**TEMPerature** This bit is set if a questionable temperature occurs.
5	**FREQuency** The bit is set if a frequency is questionable
6 to 7	These bits are not used
8	**CALibration** The bit is set if a measurement is performed uncalibrated (= ^ label "UNCAL")
9	**LIMit** (device-specific) This bit is set if a limit value is violated (see also section STATus:QUEStionable:LIMit Register). Note: Limit register is associated with limit lines for the Spectrum Mask measurement only.
10	**LMARgin** (device-specific) This bits are not used within R&S FS-K40
11	**SYNC** (device-dependent) This bits are not used within R&S FS-K40
12	**ACPLimit** This bits are not used within R&S FS-K40
13 to 14	These bits are not used
15	This bit is always 0

STATus:QUEStionable:LIMit Register

This register comprises information about the observance of limit lines in the corresponding measurement window (LIMit 1 corresponds to Screen A, LIMit 2 to Screen B). It can be queried with commands `STATus:QUEStionable:LIMit<1|2>:CONDition?` and `STATus:QUEStionable:LIMit<1|2>[:EVENt]?`.

Note that no limit lines are displayed in screen B and as such all bits in the LIMit2 register will always be set to 0.

Bit No	Meaning
0	LIMit 1 FAIL This bit is set limit line 1 is violated
1	LIMit 2FAIL This bit is set limit line 2 is violated
2	LIMit 3 FAIL This bit is set limit line 3 is violated
3	LIMit 4 FAIL This bit is set limit line 4 is violated.
4	LIMit 5 FAIL This bit is set limit line 5 is violated.
5	LIMit 6 FAIL This bit is set limit line 6 is violated.
6	LIMit 7 FAIL This bit is set limit line 7 is violated.
7	LIMit 8 FAIL This bit is set limit line 8 is violated.
8-14	These bits are not used
15	This bit is always 0

STATus:QUEStionable:PNOise Register

This contains information about phase noise measurements
The bits can be queried with commands "STATus:QUEStionable:SYNC:CONDition?" and "STATus:QUEStionable:SYNC[:EVENt]?".

Bit No	Meaning
0	This bit is not used
1	**SIGNal not found** This bit is set if no valid signal is detected
2	**VERify signal failed** This bit is set if verification failed to detect a signal within the supplied tolerances.
3 to 14	These bits are not used
15	This bit is always 0

Error Reporting

Error reporting for the K40 option is carried out using the Service Request (SRQ) interrupt in the GPIB interface. When an error occurs a Service Request interrupt will be generated. The master can then query the slave instrument for the error that triggered the interrupt Errors are queried through the "SYSTem:ERRor" command.

Table of softkeys with assignment of IEC/IEEE bus commands

Key MEAS or Hotkey PH NOISE

GENERAL SETTINGS	[SENSe]:FREQuency:CENTer
	[SENSe]:POWer:RLEVel
	[SENSe]:SWEEP:FORWard
	[SENSe]:FREQuency:VERify[:STATe]
	[SENSe]:POWer:RLEVel:VERify[:STATe]
	[SENSe]:FREQuency:VERify:TOLerance
	[SENSe]:POWer:RLEVel:VERify:TOLerance
	[SENSe]:FREQuency:STARt
	[SENSe]:FREQuency:STOP
	:DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:Y:SCALe:AUTO
	:DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel
	:DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:Y[:SCALe]
	:DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel:OFFset
	:DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:SMOothing:APERture
	:CALCulate<1|2>:EVALuation[:STATe]
	:CALCulate<1|2>:EVALuation:STARt
	:CALCulate<1|2>:EVALuation:STOP
MEAS SETTINGS	[SENSe:]SWEep:MODe
	[SENSe]:BANDwidth|BWIDth[:RESolution]:TYPE
	[SENSe]:FREQuency:STARt
	[SENSe]:FREQuency:STOP
	[SENSe]:BANDwidth:RESolution:RATio
	[SENSe]:SWEep:COUNt
	[SENSe]:BANDwidth:RESolution:TYPE
	[SENSe]:LIST:RANGe<1..18>:BANDwidth[:RESolution]
	[SENSe]:LIST:RANGe<1..18>:FILTer:TYPE
	[SENSe]:LIST:RANGe<1..18>:SWEep:COUNt
AUTOSCALE Y-AXIS	:DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:Y:SCALe:AUTO ONCE

Key TRACE

SELECT TRACE	N/A
CLEAR WRITE	:DISPlay[:WINDow<1|2>]:TRACe<1…3>:MODE
AVERAGE	:DISPlay[:WINDow<1|2>]:TRACe<1…3>:MODE
VIEW	:DISPlay[:WINDow<1 2>]:TRACe<1…3>:MODE
BLANK	:DISPlay[:WINDow<1|2>]:TRACe<1…3>[:STATe]
SWEEP COUNT	[:SENSe]:SWEep:COUNt
SMOOTHING	:DISPlay[:WINDow<1|2>]:TRACe<1…3>:SMOothing[:STATe]
ASCII FILE EXPORT	:FORMat[:DATA] ASCii MMEMory:STORe<1|2>:TRACe 1,'TRACE.DAT'
DECIM SEP . ,	:FORMat:DEXPort:DSEParator POINt | COMMa

Key SWEEP

CONTINUOUS SWEEP	INITiate:CONTinuous ON
SINGLE SWEEP	INITiate:CONTinuous OFF
SWEEP COUNT	[SENSe:]SWEep:COUNt
SGL SWEEP DISP OFF	:INITiate:DISPlay OFF

Key LINES

:CALCulate:LIMit<1 to 8>…

Key MKR

MARKER 1

MARKER 2

MARKER 3

MARKER 4

```
:CALCulate<1|2>:DELTamarker<1 to 4>[:STATe]
:CALCulate<1|2>:DELTamarker<1 to 4>:X
:CALCulate<1|2>:DELTamarker<1 to 4>:Y
:CALCulate<1|2>:MARKer<1 to 4>[:STATe]
:CALCulate<1|2>:MARKer<1 to 4>:X
:CALCulate<1|2>:MARKer<1 to 4>:Y
```

MARKER NORM DELTA

```
:CALCulate<1|2>:MARKer<1 to 4> …
:CALCulate<1|2>:DELTamarker<1 to 4> …
```

ALL MARKER OFF

```
:CALCulate<1|2>:MARKer<1 to 4>:AOFF
:CALCulate<1|2>:DELTamarker<1 to 4>:AOFF
```

Key MKR->

SELECT MARKER

```
:CALCulate<1|2>:MARKer<1 to 4>…
:CALCulate<1|2>:DELTamarker<1 to 4>…
```

MKR->TRACE

```
:CALCulate<1|2>:MARKer<1 to 4>:TRACe
:CALCulate<1|2>:DELTamarker<1 to 4>:TRACe
```

Hotkeys

SPECTRUM	:INSTrument:SELect SANalyzer :INSTrument:NSELect 1
PH NOISE	---
RUN	:INITiate[:IMMediate]

4 List of Warnings & Error Messages

The list of possible warning & error messages are shown below :

Status Bar Message	Description
No signals found within tolerance range	This message is only displayed when the *Verify Frequency & Level* parameter is set in the General Settings view. This indicates that no input signal could be identified within the supplied tolerances of the specified frequency and level. Check that the *Frequency* and *Level* parametes are set correctly. If further measurement executions give this message then try increasing the frequency and/or level tolerance ranges.
Signal not within the subsweep tolerance	This message is similar to the above, but is displayed after the initial verification has been successfully performed and indicates that the current subsweep is outside tolerance.

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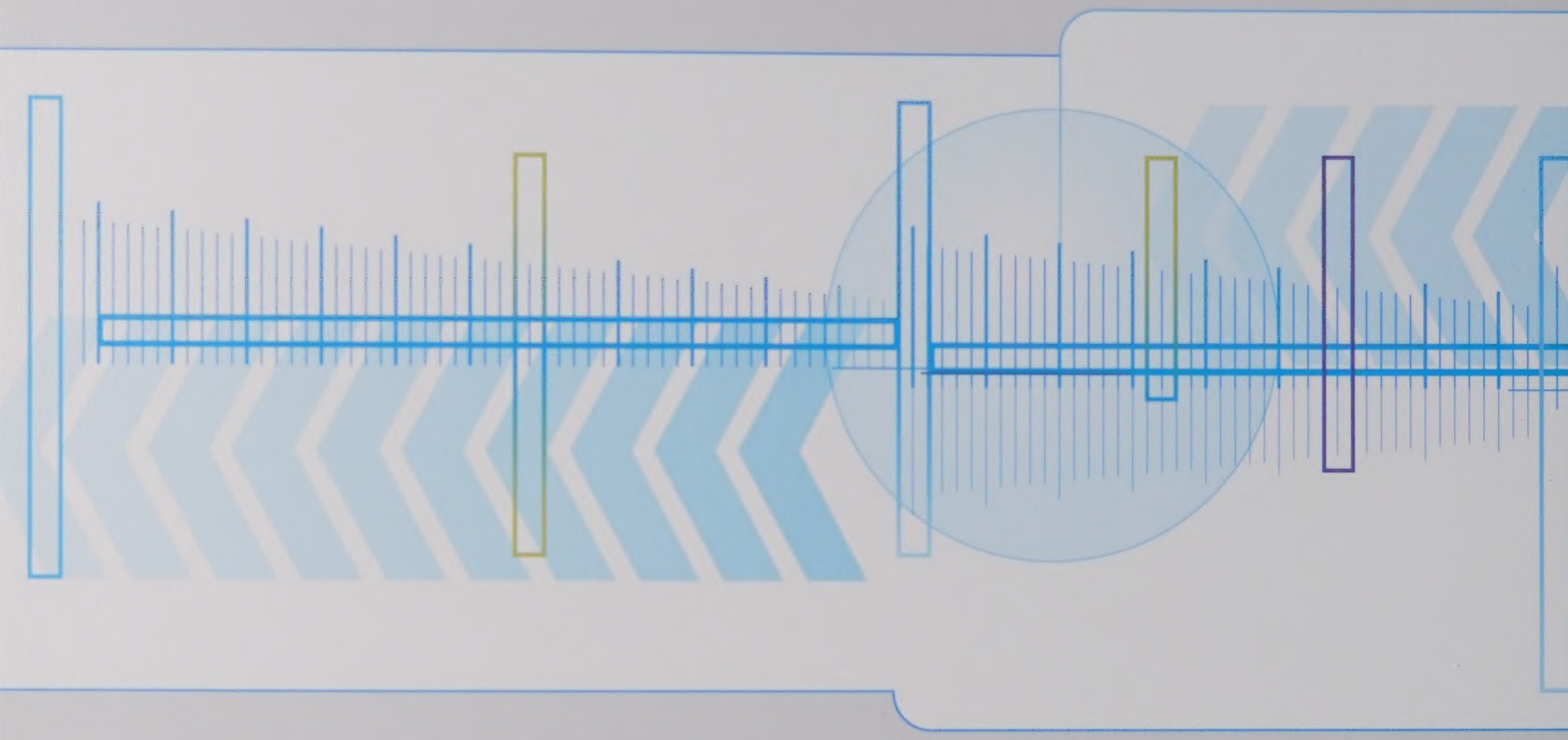

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